

HAWAII DROUGHT PLAN



PHASE 1

August 25, 2000

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LIST OF ACRONYMS

AWUDP	Agricultural Water Use and Development Plan
BMDI.....	Bhalme and Mooley Drought Index
BOR.....	Bureau of Reclamation
BWS	Board of Water Supply (Honolulu, Oahu)
CD.....	Civil Defense (State or County)
COE.....	Corps. Of Engineers
CPC	Climate Prediction Center
CWRM	State Commission on Water Resource Management
DBEDT	State Department of Business, Economic Development and Tourism
DLNR.....	State Department of Land and Natural Resources
DOA.....	State Department of Agriculture
DOFAW	State Division of Forestry and Wildlife
DOH.....	State Department of Health
DOW	Department of Water (Kauai)
DWS.....	Department of Water Supply (Maui or Hawaii)
EMOWP	East Molokai Watershed Partnership
EMWP.....	East Maui Watershed Partnership
ENSO	El Nino Southern Oscillation
EPA	Environmental Protection Agency
FCIC.....	Federal Crop Insurance Corporation
FEMA.....	Federal Emergency Management Agency
FSA	Farm Service Agency
FWS	National Fish and Wildlife Service
HACD.....	Hawaii Association of Conservation Districts
HAR.....	Hawaii Administrative Rules
HASS.....	Hawaii Agricultural Statistics Service
HDC	Hawaii Drought Council
HFO.....	Honolulu Forecast Office
HARNG.....	Hawaii Army National Guard
HRS	Hawaii Revised Statutes
HSCO	Hawaii State Climatology Office
KMWP	Koolau Mountain Watershed Partnership
MOU	Memorandum of Understanding
NDMC.....	National Drought Mitigation Center
NFDR.....	National Fire Danger Rating
NOAA.....	National Oceanic and Atmosphere Agency
NPS	National Park Service

NRCS	Natural Resources Conservation Service
NWS.....	National Weather Service
PDO.....	Pacific Decadal Oscillation
PDSI.....	Palmer Drought Severity Index
PUC	State Public Utility Commission
RAWS	Remote Automated Weather Station
SBA.....	Small Business Administration
SDC	State Drought Coordinator
SDWB	Safe Drinking Water Branch
SFA	State Fire Assistance
SOI.....	Southern Oscillation Index
SPI.....	Standardized Precipitation Index
SWCD.....	Soil and Water Conservation Districts
TNC.....	The Nature Conservancy
UH Ext.	University of Hawaii Cooperative Extension Service
UHM.....	University of Hawaii at Manoa
USDA	United States Department of Agriculture
USGS.....	United States Geological Survey
VFA.....	Volunteer Fire Assistance
WMWP	West Maui Watershed Partnership
WRC.....	Water Resources Committee

EXECUTIVE SUMMARY

Phase 1 of the Hawaii Drought Plan was prepared for use by the Hawaii Drought Council to improve and better coordinate drought management strategies for the State of Hawaii. The plan lays out a comprehensive vision for how state and local entities can work together to proactively implement mitigation measures and appropriate response actions during periods of drought to reduce and minimize the effects upon the people and natural resources of Hawaii. Experiences with past droughts have shown that the most effective approach to accomplish this goal is to coordinate mitigation response actions between federal, state, and county governments, private sector, and local citizens in a timely manner.

It is important to note that the plan has been developed as a dynamic document, which should be utilized and updated to reflect changing conditions, new information, and evolving membership in the various task forces/committees. The plan will be made available on the Hawaii Drought Website (<http://www.state.hi.us/dlnr/cwrm/drought>) to facilitate public access and the review of future updates.

Phase 1 of the Hawaii Drought Plan identified and prioritized the following key action items for immediate implementation by the Hawaii Drought Council:

1. Establish by Governor's Executive Order, the Hawaii Drought Council whose directive shall be to prepare and implement a state drought plan to coordinate and enhance current response measures and to complete implementation of priority mitigation actions to reduce the effects of drought impacts in Hawaii. The Executive Order should also establish a State Drought Coordinator (SDC) position to be assigned to the Commission on Water Resource Management for administrative purposes. The position should be established and operational by October 2000, and should be appropriately funded and used to support successful implementation of the Hawaii Drought Plan. The Hawaii Drought Council should also work with the State Legislature to determine the need for possible legislation to support the Governor's Executive Order and to address future funding requirements.
2. The HDC, in coordination with the drought task forces/committees, should identify (2-3) high priority areas and conduct a geographic-specific risk assessment and vulnerability analysis within the next 12 – 18 months. The study should include review of existing monitoring and data collection, assessment of sector-based vulnerability, response/mitigation limitations and possible solutions, and any other site-specific risk management analyses as may be needed. Based upon the results and analysis of the selected priority areas, seek to expand the risk assessment and vulnerability study to other priority areas in the state, subject to available funding.
3. Validate and refine proposed drought indices and triggers developed by the Water Resources Committee based upon correlation with historical data, past drought events, etc. for each water use sector (e.g., Water Supply, Agriculture and Commerce, and Environmental, Public Health and Safety). To the extent possible and in conjunction

with trigger validation, assess and develop more effective measures for accurately predicting the onset of drought conditions prior to reaching Stage 1 drought conditions.

4. The HDC, in coordination with each county, should develop a prototype county drought plan. One county should be initially selected for development of the county drought plan component which should be immediately undertaken and completed within 12 months. The county drought component should be used to further define county/local responsibilities, the role of the county level drought committees, the interrelationship of county plans/committees to the state drought plan, and existing county response capability, procedures, and resources. The county plan should also identify high risk issues/areas and county specific mitigation measures to reduce drought impacts within the county. Based upon the results of the initial prototype county drought plan component, determine if additional county-specific drought plans should be developed for each county.
5. Seek appropriate funding to undertake and complete preparation of the Agricultural Water Use and Development Plan (AWUDP) component of the Hawaii Water Plan within the next 12 – 18 months.
6. Encourage military involvement in subsequent drought planning activities and incorporate military drought response/mitigation provisions within Phase 2 of the drought plan.
7. Develop policy allowing emergency access to (or seek funding to develop new) standby water sources and/or storage facilities in drought prone regions for public and private use during a declared drought emergency.
8. Consider new legislation for agricultural loans or grants covering drought impacts, damages, or losses, or similar emergency funding mechanism.

Implementation of the plan provisions will become the key challenge to the Hawaii Drought Council and its agency and private sector members. Appropriate resources will need to be identified (both funding and staffing) to address the priority actions identified in the Phase 1 implementation plan. The success of the plan will ultimately be measured by the abilities of government agencies, stakeholders, and the general public to function as a team to achieve the goals and objectives necessary to successfully mitigate the impacts of drought upon the citizens of the State of Hawaii.

I. INTRODUCTION:

Drought is perhaps the most obstinate and pernicious of natural disasters which at its most severe form creates vast, windblown dust bowls-eroding the landscape, damaging terrestrial and aquatic wildlife habitat, contributing to widespread wildfire, and costing hundreds of millions of dollars. Drought moves slowly and takes months of below normal precipitation to happen and takes more than one good rainfall to catch up. Weather isn't the only cause of drought. Drought results from both natural events and from human activities that increase demand for water. Expanding populations, irrigation, and environmental awareness all put pressure on water supplies. For years, farmers and ranchers, scientists, economists, small business owners, environmentalists, wildlife managers, counties, state government, and the federal government have grappled with the far-reaching consequences of drought. Drought can lead to tough decisions regarding allocation of water, stringent water-use limitations in large urban areas, and problems in ensuring safe drinking water as well as adequate water supplies for city, county, and local fire fighting efforts. The most common conflicts during drought periods are between older, established uses such as agriculture versus newer uses such as recreation and municipal water for growing populations, and between water for direct human use and for ecosystems.

In the past, drought was addressed as a temporary emergency. Actions were taken in response to impacts, in a reactionary fashion. The most important lesson learned in recent years is that the best time to reduce the impacts of drought is before they occur. It is important to develop a plan that advocates a proactive drought management approach, and the State of Hawaii drought plan should be framed with this approach in mind.

PURPOSE

Droughts and wildland fires threaten all islands of the State of Hawaii in any given year. In early 1998, two counties in Hawaii declared drought emergencies and imposed water conservation practices. With continued economic growth and development in the wildland /urban interface areas, the negative impacts of drought in the State of Hawaii will increase in the future. Drought planning with aggressive preparedness and mitigation measures and annual updating of the plan based on lessons learned can be effective instruments in reducing property losses and in enhancing public safety from this natural disaster.

Drought planning holds great promise for reducing the drought impacts, which occur with greater warning and frequency than other kinds of disasters. This plan is based on the idea that with foresight, commitment, technology, and citizen and government cooperation, more can be done to reduce the effects of drought. Preparation for drought should be an ongoing activity to effectively mitigate its impacts when it actually occurs. Therefore, the State of Hawaii drought plan focuses on two specific activities: 1) short-term, or immediate activities to address a specific imminent impact of drought, and 2) long-term or ongoing activities that address the certainty that drought will occur sometime in the future.

The purpose of this plan is to provide a coordinated and consistent program and a framework for integrating federal, state, county, and private sector actions to reduce the impact of human suffering and to minimize property losses due to drought. Phase 1 of the Hawaii Drought Plan is intended to serve as a working guide for those agencies that have the capabilities and resources to develop effective preparedness and mitigation programs within their areas of jurisdiction. The success of this plan is heavily dependent on the coordination and commitment of all levels of government, as well as the private sector. It is well recognized that effective drought planning and mitigation programs may well reduce the need for extensive federal, state and county emergency relief expenditures usually draw upon to assist farmers and ranchers, and can assist rebuilding of local economics, and reduce conflicts over competition for water during drought.

SCOPE

Key elements to a successful drought plan should include:

- A comprehensive rainfall pattern and climate monitoring system to provide early warning of emerging droughts to decision makers, stakeholders, and the general public.
- A network of people and/or organizations who can effectively assess evolving impacts of water shortages on agriculture, recreation, hydropower, municipal and domestic water supplies, wildlife, and other areas that are sensitive to reduced rainfall and fluctuations in water supply.
- Clear policies and establishment of response entities to implement immediate and short-term response measures to reduce drought impacts and longer-term mitigation measures to reduce the future impacts of droughts.

The Drought Plan should also include a description of historical occurrences, climatological statistics, risk assessments of susceptibility and vulnerability to drought, as well as identification of potential impacts related to specific geographical locations. The plan emphasizes identification of pre- and post drought preparedness and mitigation measures for implementation by government agencies, stakeholders, and the general public.

The Hawaii Drought Plan establishes a leadership structure comprised of the:

- Hawaii Drought Council
- State Drought Coordinator
- Water Resources Committee
- Environmental, Public Health, and Safety Drought Task Force
- Water Supply Drought Task Force
- Agriculture and Commerce Drought Task Force
- County-Level Impact Committees.

Participation in these groups is designed to include, but not be limited to, individuals and/or organizations that can best share their expertise and familiarity about local issues, resources, and priorities regarding drought preparedness and response. Perhaps, more importantly, membership

in these committees should be comprised of individuals who can effectively communicate and interact with their constituents with regard to implementation of mitigation measures established as part of this plan.

The plan also proposes development of a public outreach component consisting of drought-related projects, educational-based programs, and development and initiation of statewide water conservation measures. In addition, the drought plan makes several recommendations regarding performance of risk management assessments pertaining to potential drought impacts.

GOALS AND OBJECTIVES

The goals and objectives of the Drought Leadership Structure identified above can be briefly described as follows:

- Timely prediction and monitoring of pre- and post-drought conditions;
- Risk assessment of drought-related impacts to agriculture, municipal and industrial water supply, fire, environment, and island economies;
- Mitigation of drought effects through effective planning actions during both drought and non-drought periods; and
- Timely dissemination of drought-related information and data to the general public and affected federal, state and county agencies.

As noted above, the success of any plan is tied to the effectiveness of its communication and public outreach component. Accordingly, the Hawaii Drought Plan appropriately recognizes the need to develop an effective information dissemination system that incorporates several communication techniques targeting water users statewide. These techniques include, but are not limited to, e-mail, faxes, agency/community newsletters, public notices, press releases, and/or Internet websites. Similarly, TV and radio spots should be included as communication options to address major drought affected customer groups. Current communication networks utilized by existing organizations (e.g. "Hawaii Crop Weather" by the National Agricultural Statistics service, "Pacific ENSO Update" by the Pacific ENSO Application Center, etc.) should be incorporated in the development of a coordinated drought communication system or public outreach program. The net effect of these efforts must, however, result in timely delivery and accurate communication of needed data to government decision-makers, the general public and stakeholders groups.

PLAN DEVELOPMENT

In conjunction with the development of Phase 1 of the Hawaii Drought Plan, statewide public workshops were held on each island during the week of August 7–11, 2000. In addition, a 30-day review and comment period was provided to receive additional public input on the plan.

Written comments submitted (and on file with DLNR) were taken into consideration and are reflected within Phase 1 of the plan. These concerns, along with other recommendations identified during the initial assessment of sector-based impacts will be more definitively addressed in the next phase (and future iterations) of the Hawaii Drought Plan.

It should be noted that one of the major objectives of Phase 1 of the HDP was to develop a planning framework in which to address a multitude of drought-related issues. The plan is structured to be dynamic in nature, utilizing a “living document” approach to deal with more than just response-oriented actions.

Under this approach, the proposed Drought Leadership Structure may change from time to time. Accordingly, provisions have been established to address such changes, as well as to allow for periodic evaluation and revision to the plan itself. With regard to future plan revisions, the following plan format has been developed to facilitate prospective modifications to the plan:

- To guarantee flexibility in the plan’s content, a loose-leaf format is proposed as opposed to a bound document. The loose-leaf format will allow for modification of the original plan with the least amount of cost and delay.
- To allow access to the plan by the largest possible audience, without the need for massive document publication costs, the Hawaii Drought Plan will be posted on the Internet initially at the Interim Hawaii Drought Website (<http://www.state.hi.us/dlnr/cwrn/drought/>). Timely updates on the status and progress of specific actions undertaken by the Water Resources Committee and/or respective Drought Task Forces will be posted to the website. It is hoped that this process will allow the greatest flexibility and access for continued review, modification and public use of the drought plan and the data contained therein.

II. BACKGROUND

DROUGHT DEFINED

The definition of drought may have profound implications for the environment and all segments of society, yet it may be different for each. A generic definition may be “Drought is a persistent and extended period of below normal precipitation causing abnormal moisture deficiency having adverse effects on people, animals, and crops.” Drought diminishes natural stream flow; depletes soil and subsoil moisture, and these effects cause social, environmental, and economic impacts. A definition of drought may have different functions depending on the goals to be achieved. The definition must be flexible enough to include a variety of drought situations, yet specific enough to distinguish between various situations, such as true drought emergencies versus normal cyclical conditions.

The United States experiences two types of drought. One type occurs when large stores of water in man-made reservoirs, natural lakes, and ground water aquifers are depleted by very long, unusually low periods of precipitation. This type of drought is called “Stored Water” drought. The second type of drought may be called “Natural Water” drought. It happens quickly and fairly frequently after just a few weeks or months of below normal rains and has its greatest impacts on farmers and ranchers who do not rely on irrigation and on some rural communities and the environment.

HAWAII DROUGHT SUSCEPTIBILITY

Droughts have affected the Hawaiian Islands throughout its history. Farmers, cattle ranchers, and individuals who rely on catchment water systems and surface stream diversions are the most severely affected communities by drought. Wildland fires are susceptible to very dry conditions and have considerably increased in the state. Droughts have impacted almost every island in Hawaii with the most severe ones in the past 15 years associated with the El Nino phenomenon. During the El Nino years, droughts have occurred during the winter-spring period. As an example, in January 1998, the National Weather Service’s network of 73 rain gauges throughout the State did not record a single above-normal rainfall with 36 recording less than 25 percent (NWS Honolulu Forecast Office). The 0.14 inches of rain recorded for the city of Hilo is the lowest monthly total ever observed for any month since records have been kept. Normal January average rainfall for Hilo is 9.88 inches. Parts of the island of Hawaii have had less than 10 percent of the normal rainfall until May 1998. Also, rainfall has been lower than average on Oahu with many areas experiencing only one-third of normal rainfall.

Thus, droughts have been an integral part of Hawaii’s history and will probably continue in the future in a more severe form. The major crisis because of severe drought situations are water shortages for human consumption, agricultural irrigation and severe fire hazard in the forest reserve. Lack of development of sufficient water resources and water distribution systems to accommodate an increase in population may result in water shortages that become significantly critical. Crop damage and cattle losses have been major concerns during periods of severe

drought, resulting in the implementation of both voluntary and mandatory water conservation measures. The ongoing drought has wreaked havoc on the farmers and ranchers of Hawaii, especially those on the southeastern end of the state. Ranchers are grass farmers and the drought to ranchers means less grass. As a result, the cattle which graze the land, suffer. The unpredicted three year drought has left the State of Hawaii with reduced carrying capacity (less cows), lower calf crops, and lower weaning weights, resulting in an enormous loss of revenues. Furthermore to sustain the animals it is necessary to purchase supplemental feed and minerals, and many have experienced increased water costs. According to the statistics given by the Hawaii Cattlemen's Council, the estimated losses the beef cattle industry experienced in 1999 is over \$1.7 million and for 2000 the forecast is that the tentative loss will be over \$5 million because of persistent drought conditions.

The above estimates emphasize the seriousness of drought-related economic losses by Hawaii cattlemen. The counties of Hawaii and Maui are broadly affected by persistent drought conditions, while Oahu and Kauai are partially affected. The economic impacts of drought on Hawaii's cattle industry (i.e. estimated drought-related loss) for 1999 and 2000 have been evaluated. Increased cattle mortality and reduced calving rates lead to a direct loss in the total number of marketable cattle. The average live weight for all marketed cattle in 1999 decreased by about 10%. Consequently reduced live weights in this group of animals resulted in less than anticipated revenue. In addition to current financial losses, overall cattle inventory has been reduced by lower calving rates and sell-off of mature cattle due to the unavailability of inexpensive feed or forage. This inventory reduction will contribute to economic losses for several years following drought resolution. The estimated loss for cattle death over normal was 4%, reduction in weaned weights was 89 (lbs/head), and the reduction in wean percent was 3% statewide in 1999. The dollar losses from reduced wean weight is \$3,291,241, from reduced calf crop is \$687,940, and from increased mortality is \$2,495,750, totaling a financial loss of \$6,474,931 in 1999. The estimated total financial loss in the same areas mentioned above is projected to be \$9,078,360 in 2000.

Most severe droughts on record in Hawaii have been associated with El Nino– 1982/1983 and 1997/1998. According to the Pacific El Nino- Southern Oscillation Application Center, the dry conditions, in general, have been associated with persistent zones of high pressure systems throughout the islands. This feature related to El Nino is typical in the tropical Pacific.

Tables 1, 2 & 3 describe the history of most severe droughts, and the Precipitation Figures for the Islands of Hawaii.

Table 1: History of Most Severe Droughts

Year	Areas	Remarks
1901	North Hawaii	Serious drought, destructive forest fires.
1905	Kona, Hawaii	Serious drought and forest fires.
1908	Hawaii and Maui	Serious drought.

Year	Areas	Remarks
1912	Kohala, Hawaii	Serious drought and severe sugarcane crop damage for two years.
1952	Kauai	Long, severe dry spell.
1953	Hawaii, Kauai, Maui, and Oahu	Water rationing on Maui; water tanks in Kona almost empty; 867 head of cattle have died; pineapple production on Molokai reduced by 30 percent; rainfall in the islands has been 40 percent less than normal.
1962	Hawaii and Maui	State declared disaster for these islands; crop damage, cattle deaths, and severe fire hazards; losses totaled \$200,000.
1965	Hawaii	State water emergency declared; losses totaled \$400,000.
1971	Hawaii and Maui	Irrigation and domestic water users sharply curtailed.
1975	Kauai and Oahu	Worst drought for sugar plantations in 15 years.
1977-1978	Hawaii and Maui	Declared State disaster for these islands.
1980-1981	Hawaii and Maui	State declared disaster; heavy agricultural and cattle losses; damages totaling at least \$ 1.4 million.
1983-1985	Hawaii	El Nino effect; State declared disaster; crop production reduced by 80 percent in Waimea/Kamuela area; \$ 96,000 spent for drought relief projects.
1996	Hawaii, Maui, and Molokai	Declared drought emergency; heavy damages to agriculture and cattle industries; losses totaling at least \$ 49.4 M.
1998	Hawaii and Maui	State declared drought emergency for Maui; County declared emergency for Hawaii due to water shortages.

Table 2: Precipitation Figures for Hilo, Hawaii, in 1998 (Severe Droughts)

Month	Actual Precipitation Inches	Departure from Normal Inches
January	0.13	-9.75
February	2.4	-7.89
March	1.67	-10.25
April	8.86	-6.4

Table 3: Precipitation figures for Kahului, Maui, in 1998 (Severe Droughts)

Month	Actual Precipitation Inches	Departure from Normal Inches
January	0.36	-3.78
February	0.49	-2.38
March	0.18	-2.54
April	1.27	-0.57

III. DROUGHT LEADERSHIP STRUCTURE

This section presents the structure, function and responsibilities of the organization dealing with drought related issues at the state and local level including the: Hawaii Drought Council, State Drought Coordinator, Water Resources Committee, the three Drought Task Forces, and County/Local Committees.

HAWAII DROUGHT COUNCIL

The Hawaii Drought Council is the steering group that oversees the implementation of drought related activities in the State of Hawaii. The Hawaii Drought Plan should be implemented in conjunction with existing agency authority and responsibility, and shall provide for coordination of services to lessen the impacts of drought. The Council consists of department heads of the key state drought response agencies consisting of the Department of Agriculture (co-chair), the Department of Land and Natural Resources (co-chair), the Department of Defense, the Chief of Staff from the Governor's Office, and four (4) County Officials designated by the Mayors. In addition, ex-officio members participate in the Council activities as advisors. They include the Hawaii Association of Conservation Districts, Hawaii Farm Bureau, Hawaii Cattlemen's Council, and private water purveyors.

The Hawaii Drought Council will provide leadership to accomplish the following:

- With approval of the Governor, develop, implement and maintain a state drought plan;
- Review and report drought monitoring information to the public;
- Coordinate timely drought impact assessment;
- Identify areas of the state with a high probability of drought and target reporting and assistance efforts to those areas;
- Upon request, assist in organizing local/county drought committees;
- Authorize state agency staff to provide technical assistance to local drought committees;
- Promote ideas, programs and activities for groups and individuals to implement that may mitigate the impacts and reduce drought vulnerability.
- Propose legislation to state and county legislative bodies for required resources.
- Act as recipients for federal grants, direct appropriation and local matching for federal assistance.
- Act as coordinating agency for disbursement of emergency aid obtained from all sources in accordance with the drought plan.
- Promulgate and administer rules, as may be necessary to implement recommended drought mitigation measures.

The Council will meet at least once a year to review current drought conditions, ongoing monitoring activities, and planned mitigation and public out-reach work identified in the drought plan. The Council may meet more often during periods of drought or if conditions or circumstances warrant. The meeting time, location, and agenda will be coordinated by the co-

chairs in consultation with the other council members. The Council should schedule meetings if drought indices indicate moderate drought or an “Alert” status exists for at least one county. All meetings will be public meetings with adequate notice provided so to ensure that the public’s participation.

The Council will serve as liaison between the various task forces involved with drought planning/response and the Office of the Governor. It will also assume the lead role in intergovernmental drought response coordination and media information releases.

STATE DROUGHT COORDINATOR

A state drought coordinator position should be established as soon as possible to provide continued focus and leadership regarding drought-related issues. The coordinator would be responsible for the following tasks:

- Manage the state drought plan and ensure that it is maintained;
- Provide administrative support to the Hawaii Drought Council, Water Resources Committee, Drought Task Forces and Local Committees;
- Manage the drought web site;
- Ensure that timely water resources and drought forecasts are completed and provided to the public;
- Track assigned work items from the state drought plan to ensure implementation and follow-through;
- Provide a focus point to manage federal, state and local assistance programs and assist with acquiring funding for program implementation; and
- Be the principle spokesperson and contact with the public on drought related issues
- Act as legislative liaison
- Develop and implement specific projects and programs as directed by the Hawaii Drought Council

WATER RESOURCES COMMITTEE

The Water Resources Committee is the core of the Hawaii State Drought Plan. The Committee is responsible for monitoring all available climatological data, soil moisture readings, reservoir storage levels, ground water conditions, weather forecasts and other pertinent information necessary to analyze the current status and forecasted level of drought conditions in the State of Hawaii. This group of water resource, agricultural and climate professionals assesses information, makes evaluations as to the current and future status of drought in the State, advises other work groups and task force members as to the current status level of drought in the State, and, as necessary, responds to “triggers” to implement further actions by the other task forces.

The Water Resources Committee is co-chaired by the State Commission on Water Resource Management and the Honolulu Board of Water Supply. Other members include representatives from the County water departments, Hawaii Agricultural Statistic Service, National Weather

Service, State Civil Defense, U.S. Geological Survey, the State Climatologist (U of Hawaii), and key stakeholders (see Appendix 2 for committee member list).

The Water Resources Committee also coordinates the dissemination of drought-related information such as drought forecast information and provides links to other sources of information/data which include the Interim Hawaii Drought Website and U.S. Geological Survey's Internet Websites.

The committee will provide monthly updated reports during drought conditions. Reports will be cleared with the co-chairs of the Drought Council prior to dissemination to other committee/task forces chairs, the public or posting on the Interim Hawaii Drought Website. During periods of moderate to severe drought more frequent reports (weekly) may be utilized to maintain up-to-date communications with the Hawaii Drought Council and drought task forces, and the general public. Meetings of the committee will occur at least once annually (more often during periods of droughts) to review recently completed and/or planned work, to evaluate current monitoring data, and to assess existing "drought-triggers," if any. Such meetings should also be used as an opportunity to update committee members on forecasts or other issues related to drought. Conference calls and other informal communication may be used to conduct business of the committee and to provide information to the public and decision-makers.

DROUGHT TASK FORCES

The Drought Task Force component is comprised of three specific functional groups representing various sectors potentially impacted by drought and includes those agencies responsible for drought impact mitigation and assistance. Membership of the task forces includes a wide range of expertise but generally represents diverse sets of professionals who have experience in the planning, analysis, and use of water, agriculture, natural resources, fire, public health and safety and economic resources. They represent the core of the task forces responsible for assessing the vulnerability of their particular sector's affected "customers," developing long range strategies for assisting their customers, and developing mitigation and response alternatives to known and unforeseen problems.

The Drought Task Forces monitor and assess current and potential impacts of impending or ongoing drought upon the State's economy, environment and natural resources. The Task Forces shall initiate any and all appropriate drought responses within the capabilities of existing state and federal resources, and advise the Drought Council of any needs that cannot be met through existing in-state resources. The initial findings and recommendations of the task forces are assimilated into the overall drought plan and help assure efficient response and mitigation capabilities and documentation for any emergency declaration. Individual agency programs, however, are not subject to approval by this task force, which serves only to augment existing capabilities.

Meetings of the Task Forces will usually occur at least once annually (more often during periods of droughts) to review work completed in the recent past, assess work to be completed in the near future, update committee members on forecasts or other issues related to drought.

Conference calls and other informal communication may be used to conduct the business of the committee and to provide information to the public and decision-makers.

Water Supply

This Drought Task Force is an assessment, mitigation and response group which collects data and develops strategies for drought related impacts on a variety of water supply issues such as rural and urban drinking water systems, agricultural water systems and other sources, to identify drought impacts, track their occurrence and determine intensity. The assessments are based upon available data including, but not limited to, information from water system managers and vulnerability assessments of public water utility systems

The task force will be co-chaired by a County Water Official and a Private Water System Manager. Additional participants include: Representatives from each county water department, Commission on Water Resource Management, DHHL, Department of Agriculture, Private Agricultural Water Purveyors, Private Domestic Purveyors, State Civil Defense, and other stakeholders (see Appendix G for list of participants).

Agriculture and Commerce

The agricultural industry is severely impacted and damaged by droughts due to its dependency on rainfall and surface water sources. Drought impacts are not readily discernible and the effects are long-term, i.e. stress on livestock from inadequate drinking water causes disruption in the normal cow-calf relationship and reduction in healthy herds, soil erosion potential greatly increased due to drying of ground cover, etc. There is an urgent need to disseminate information concerning unpublished effects of drought and to better educate the industry on how to mitigate the risks from droughts.

This Task Force should assemble periodically to review the forecasts provided by the Water Resources Committee and to coordinate with appropriate federal, state, and county governmental agencies regarding the assessment of potential drought conditions occurring in any given year. The task force should also monitor the effects of ongoing droughts as they may be in progress and coordinate guidance for affected sectors (i.e. farms and ranches), to obtain financial relief from available governmental resources.

The Agriculture and Commerce Task Force is comprised of the Department of Agriculture (DOA), Hawaii Association of Conservation Districts (HACD), Hawaii Farm Bureau Federation, Hawaii Cattlemen's Council, Department of Land and Natural Resources, Commission on Water Resource Management, USDA Natural Resources Conservation Service, USDA Farm Services Agency, farmers, ranchers, major landowners and other stakeholders (see Appendix G for list of participants).

Environment, Public Health and Safety

The threat of wildfires in rural and forested areas is an activity that threatens lives and property. The closure of major sugar plantations in recent years has also enhanced the risk of fire in areas

that were once cultivated. Drought conditions increase the severity of wildfire threat and strain normal fire defenses. As drought conditions worsen, there is a need to make assessments and identify potential short- and long-range fire protection impacts. Such evaluations are essential so that ongoing protection programs can be effectively strengthened to counter expected threats.

This Drought Task Force is an assessment, mitigation and response group which collects data from existing sources to identify drought impacts, track their occurrence, identifies vulnerable areas of concern and determine intensity on a variety of environmental, public health, fire and other issues.

The task force is co-chaired by the State Department of Land and Natural Resources, Division of Forestry and Wildlife and the Department of Health, Safe Drinking Water Branch. Additional participants include: Representatives from the State Fire Council, State Civil Defense Agency, County Civil Defense Agencies, County Fire Departments, and other stakeholders (see Appendix G for list of participants).

COUNTY/LOCAL COMMITTEES

County/local committees will be very important to the future implementation of effective drought planning and mitigation for Hawaii. The local-based organizations will be the first to identify drought effects, be responsible for initial implementation of mitigation activities, and generally be the first to respond and manage public health, safety and fire related issues. Primary activities of the local committees include: monitoring, reporting, assessment, and response (see Appendices C-F). The local committees should identify those areas of highest risk and then develop specific strategies to mitigate the effects of drought. Primary areas of concern include: domestic and municipal water supply, fire suppression, agricultural water use, limitations on sewage discharge, and impacts to fish and wildlife, recreation, tourism and energy use. Planning for situations in advance increases the likelihood that a response will be timely in minimizing the potential economic and resource loss. Local committees should engage in long-term activities to address droughts including: water conservation education, preparation of water use ordinances for communities, public service announcements, technical support from state or federal agencies, and assistance to municipal water suppliers to ensure water needs are addressed.

Membership should include participation from a variety of backgrounds and professions. Participants with experience in drought response/mitigation and businesses directly affected by drought should be involved. The local committees will also become a focus point for exchange of information between the Drought Council, Water Resources Committee and the other Task Forces.

Further assessment and clarification of county/local committee responsibilities during drought emergencies, specifically as they relate to the overall function of the HDC and the respective committee/task forces shall be undertaken in Phase 2 of the plan.

IV. DROUGHT MONITORING AND RESPONSE

The Water Resources Committee (WRC) under the leadership of the Hawaii Drought Council (HDC) met in May, 2000 in Hawaii and decided that the WRC will be involved in monitoring and prediction of drought, identification of drought indices, and development of “triggers” to respond to drought for the State of Hawaii. The committee also discussed reporting requirements and proposed to issue a monthly report on updated drought conditions.

MONITORING AND PREDICTION

Taking a proactive approach to drought management requires continuous monitoring of factors indicating the onset and extent of drought conditions. This approach serves to lessen the element of surprise and allows time for planning and implementing drought mitigation strategies. Monitoring activities are increased as conditions warrant and continue as long as drought conditions persist. Monitoring also provides continuous feedback to decision-makers and helps determine the short-term actions and response functions.

During the WRC meeting as mentioned above three categories of current monitoring or data collection were identified as they relate to monitoring and assessment of drought conditions. These monitoring efforts included climate and weather, surface water monitoring, and ground water monitoring.

Climate Monitoring and Data Collection

Federal Agencies

The National Weather Service (NWS):

- Operates 70 real-time rainfall stations (located for flood purposes) with 15 stations co-located with long term stations
- Oversees 220 cooperative network stations (4-5 month delay in receiving data)
- Has access to Climate Prediction Center forecasts (four stations inappropriate for drought)
- *Monthly Rainfall Summary* for the state

United States Geologic Survey (USGS):

- 40 rainfall stations (most stations cooperatively funded with other government agencies)

National Park Service (NPS):

- Remote automated Weather Stations (RAWS) in Haleakala National Park and Hawaii Volcanoes National Park
- National Fire Danger Rating (NFDR) computed for RAWS stations

Department of the Army:

- RAWS stations in Makua Valley (3) and Schofield Barracks Area on Oahu, and at the Pohakuloa Training Area on the Big Island

U.S. Department of Agriculture/Hawaii Agricultural Statistics Service (HASS):

- Publishes weekly *Hawaii Crop Weather* showing impact of weather on crops
- Publishes *Monthly Livestock Review*
- Both reports available at <http://www.nass.usda.gov/hi>
- Publications have circulation of about 700

State Agencies

University of Hawaii – Manoa (UHM):

- Hawaii State Climate Office focuses on climate research and functions as a historic climate data clearinghouse

Commission on Water Resource Management (CWRM):

- Operates two rainfall stations on the Big-Island, data is compiled and archived within the CWRM

Division of Forestry and Wildlife (DOFAW):

- RAWS on Makaha Ridge and Moloaa Dairy, Kauai; Polipoli (Kula), Maui; and Puuwaawaa, Hawaii
- Fire Danger Rating computed for certain RAWS stations

County Agencies

Kauai Department of Water (DOW)

- Allows co-locating of USGS rainfall stations at some DOW facilities

Honolulu Board of Water Supply (BWS)

- Operates 17 manually-read rain gages
- Computes rainfall index (% of average)

Maui Department of Water Supply (DWS)

- Information to be added

Hawaii Department of Water Supply (DWS)

- Monitors rainfall stations (coop. With NWS)

Private

- Collection of rainfall data
- Weather monitoring conducted by private agricultural interests
- HC&S has network of RAWS stations for plume management

Surface Water Monitoring and Data Collection

Federal Agencies

USGS (most data collection sites cooperatively funded with other government agencies)

- Operates 74 continuous stream, spring, and ditch gages throughout the state
- Real-time data from 7 stream gages published on the Internet (<http://hi.water.usgs.gov>)
- Annual peak flood discharges monitored at 88 crest stage gages
- Water quality data collected at 6 stream gage locations, and at 28 other miscellaneous sites
- Publishes annual report: "Water Resources Data-Hawaii"
- 3 more real-time stations to be operational by September 2000
- A Hawaii monthly current conditions report will be published on the Internet by September 2000

State Agencies

CWRM

- Collects limited data on surface water diversions; data is compiled and archived within CWRM

Department of Agriculture (DOA)

- Collects surface water data on all state irrigation systems

Department of Health, Safe Drinking Water Branch (DOH, SDWB)

- Collects and monitors drinking water quality data for public water systems

County Agencies

Kauai DOW

- No activity

Honolulu BWS

- Information to be added

Maui DWS

- Raw water reservoirs monitored daily
- Wailoa Ditch flows monitored and recorded daily
- Water treatment plant production recorded daily
- *Upcountry Water Report* prepared daily (combines surface and ground water sources)

Hawaii DWS

- Reservoir levels monitored daily
- Spring outputs monitored
- Surface water flows monitored daily

Private

- Surface water monitoring by private agricultural interests.

Ground Water Monitoring and Data Collection

Federal Agencies

USGS (most data collection stations cooperatively funded with other government agencies)

- Water levels recorded at 84 observation wells
- Water quality data taken at 40 wells

State Agencies

CWRM

- Collects data from three deep monitor wells: (2) on Oahu, and (1) on Maui
- Four more deep monitor wells planned for completion within the year: (1) on Oahu, (1) on Maui, and (2) on Hawaii
- Collects pumping reports from major water users in the state (includes majority of all permitted users on Oahu and Molokai)
- Collects water level data in the Kona region on the Island of Hawaii
- Collects chloride data in Ewa-caprock region on the Island of Oahu

DOH, SDWB

- Collects and monitors drinking water quality data for public water systems

County Agencies

Kauai DOW

- Meters wells
- Collects chloride data
- Collects water level data
- Works cooperatively with USGS on groundwater level monitoring at some monitor wells in Lihue

Honolulu BWS

- Meters wells
- Collects data from:

- 20 groundwater monitor wells
- 13 deep monitor wells (transition zone)
- Chloride levels monitored
- Monthly and weekly reports of pumpage, rainfall, and groundwater levels (internal)
- Developing groundwater index for monitoring

Maui DWS

- Pumping recorded daily
- County-wide pumping data summarized monthly
- Iao and North Waihee aquifer pumping summarized weekly and monthly
- Collects chloride data
- Collects water level data

Hawaii DWS

- Meters pump hours and consumption for deep wells and booster pumps on a daily basis
- Collects chloride data
- Collects water level data

Private

- Groundwater monitoring by private agricultural interests

Deficiencies in Present Data Collection

- Availability of a reliable drought forecast methodology.
- SPI maps for each island.
- Gaps in present data collection, coordination, and integration with other ongoing agency data analysis (e.g. Pacific Disaster Center).
- Lack of risk/vulnerability assessments, which can facilitate prioritization of site selection and data collection efforts.
- Soil moisture data.
- Improve surface water monitoring (stream diversions, ditch systems, reservoirs).
- Long-term data sets for valid statistical analysis.
- Data that is available in a reasonable time frame or close to real time in most cases.
- Data used in analyses to be in accessible electronic databases.
- More data respective to drought conditions (e.g., rain gages in remote locations, stream and ditch flow monitoring gages).

DROUGHT INDICES

There are two popular drought indices. The Palmer Drought Severity Index (PDSI) was not appropriate for Hawaii and it was decided that the Standardized Precipitation Index (SPI) should be used as an initial drought index for the state.

The Standardized Precipitation Index (SPI) was developed by Thomas McKee at Colorado State for use as a drought monitoring tool and has been embraced by agencies such as the National Drought Mitigation Center and the Western Regional Climatic Center. The beauty of this index is its simplicity because it uses only monthly rainfall as its input. This simplicity also makes it ideal for use in Hawaii, where there is a relatively dense network of rain gages. In comparison, the Palmer Drought Severity Index, which is in widespread use across the Mainland U.S., is much more complex and requires temperature and soil moisture as additional data inputs. These types of additional data are either sparse or non-existent in Hawaii. Furthermore, the PDSI is more applicable to broad climatic areas and is not suited for representing conditions in the small-scale climatic zones of the Hawaiian Islands.

Because the SPI values are normalized, the wide range of rainfall conditions across Hawaii can be assessed on an equal basis. Furthermore, SPI values can be generated for multiple time scales. This is extremely useful for monitoring purposes because drought affects the various sectors over a wide range of time scales. Finally, since the SPI uses standard statistical principles, it can also be used to monitor other data such as stream flow, reservoir levels, and ground water levels. Table 4 is an example of a drought classification scheme based on SPI.

Table 4: Drought Classification based on SPI

SPI Values	Designation	Time in category
0.00 to -0.99	Mild Drought	34.1%
-1.00 to -1.49	Moderate Drought	9.2%
-1.50 to -1.99	Severe Drought	4.4%
-2.00 or less	Extreme Drought	2.3%

The Honolulu Forecast Office (HFO) of the National Weather Service (NWS) has already tailored the SPI software for use in Hawaii. At present, 59 sites have been selected as part of the SPI monitoring network. These sites are separated into two groups called the “quick-look sites” and the “standard sites”. The “quick-look sites” use data from selected real-time reporting stations that comprise HFO’s flash flood monitoring network. Only 16 out of 69 real-time reporting stations are available for use in SPI calculations due to the fact that most of these locations have short periods of record that can result in risky statistical inferences. The main benefit of the “quick-look site” is that the data are available immediately after the end of a month so that SPI values can quickly determined. The “standard sites” are selected locations from the NWS Cooperative Observer network. Rainfall readings at these sites are taken manually and submitted via mail after the end of the month to the NWS Pacific Region Headquarters for preliminary quality control. The monthly data for the “standard sites” are intercepted at this point and forwarded to HFO for SPI calculations. The benefits from the “standard sites” are

reliability of readings and long periods of record (some stations have 100+ year records). The main drawback is the time lag since roughly one month passes by the time HFO receives “standard site” data for SPI calculations.

Dissemination of SPI values will be via the HFO web site. The data will also be incorporated into the Hawaii Monthly Rainfall Summary published by the HFO Senior Service Hydrologist. Average SPI values for different climatic zones will also be calculated for the purpose of generating SPI maps. The URL for the HFO web site is www.nws.noaa.gov/pr/hnl/index.shtml.

In addressing possible drought indices, the Southern Oscillation Index for El Nino events and the Bhalme and Mooley Drought Index were also mentioned and briefly discussed. It was noted, however, that the HDC should consider SPI values together with other indices and factors when making any drought-related decisions.

Palmer Drought Severity Index (PDSI)

- Not a good index for Hawaii due to varied geography and climate, index has inherent lag time, and requires soil moisture data component which is currently unavailable for Hawaii

Standardized Precipitation Index (SPI)

- Will be used as an initial indicator of drought conditions (in combination with other indices)

Bhalme and Mooley Drought Index (BMDI)

- May be helpful, if not too difficult to calculate

Other Indicators of Drought (if available)

- Current and projected reservoir storage levels
- Current stream flow data
- Short-range weather forecasts
- Current soil moisture levels
- Honolulu BWS Low Groundwater Conditions
- Division of Forestry and Wildlife Fire Danger Rating and Fire Weather Index
- DOA special reports for agriculture and livestock losses
- FSA applications for emergency funding
- NRCS applications for emergency funding
- Department of Defense (Civil Defense) / State and Federal Forestry fire-related reporting and monitoring; actual burn data

Southern Oscillation Index (SOI)

- El Nino indicator, could be used to initiate conservation measures

Pacific Decadal Oscillation (PDO)

- The PDO is derived from the leading eigen mode of the North Pacific sea surface temperatures. It is a low-frequency (i.e., slowly varying) phenomenon and is marked by a warm and cold phase, each one lasting for about 20 to 30 years. The recent

warm phase began in 1977, coinciding with more frequent and stronger El Nino events as we saw during the last 20 yrs (e.g., very strong 1982-83, 1986-87, 1991-92, 1994-95, and very strong 1997-98 events). Because El Nino results in drought in Hawaii, the PDO may enhance El Nino, leading to a prolonged and/or severe Hawaiian drought. A preliminary analysis of Oahu rainfall index does show an interdecadal variability, with a sequence of low rainfall during the last 25 yrs. The PDO index can be used as a guidance of the longer term rainfall behavior.

TRIGGERING MECHANISMS

Because of the extreme variability of Hawaii's climate, it was decided that where applicable drought triggers should be developed for different stakeholder sectors from both a statewide perspective and for different regions within each island (e.g., Agriculture Sector for the West Maui Region). It was also noted that a time duration component should be included when considering trigger mechanisms. In addition, it was also recommended that other drought characteristics besides SPI indices should be presented when describing various drought stages. It was suggested that perhaps matrices (tables) could be constructed to depict the different drought scenarios and associated drought characteristics. The WRC also decided that for purposes of response and mitigation, there should be three levels or stages of drought: Stage 1, Stage 2, and Stage 3.

Description of Drought Stages

Table 5 below is adapted from "Drought Indices", Dr. Michael Hayes, National Drought Mitigation Center. It categorizes drought in terms of an SPI value based on McKee et al. (1993). The McKee table is based on studies done in Colorado and may not directly apply to Hawaii's climate. This information, however, was considered a good starting point for the proposed quantification of drought stages in Hawaii. Nonetheless, further study should be conducted to compare historical drought events with their corresponding SPI values for the purpose of validating the proposed drought stage "triggers."

Table 5: Drought Stage Categorization based on SPI value

Drought Category	SPI Values	Time in Category
Near Normal	.99 to -.99	68.2%
Stage 1 (moderately dry)	-1.0 to -1.49	9.2%
Stage 2 (severely dry)	-1.5 to -1.99	4.4%
Stage 3 (extremely dry)	-2.00 or less	2.3%

Validation of Indices and Sector Sensitivity

One of the challenges in using any drought index is the need to correlate the index value to an actual drought condition. Indices may be validated by comparing historically reported drought events with computed indices for the same period and in coming up with meaningful correlation.

The Water Resources Committee brought up the following discussion points on this issue:

- Need to determine time intervals for SPI calculation. Do we use 1-, 2-, 3-, 6-, 12-month SPIs? Probably a combination since this depends on the sensitivities of the different sectors out there, such as crop production, livestock, ground water supply, catchment water supply, wild fire, etc.
- Need to determine a minimum duration, or the minimum period that the index exceeds threshold for a drought event to exist.
- Need to determine a maximum break period, or the maximum period within a drought that the index is allowed to rise above threshold.
- The SPI needs to be calibrated. In other words, critical thresholds need to be refined based on observed impacts to the community. This will take time to establish.

These are extremely important issues that must be addressed in greater detail to provide useful information to the other task force committees. However, due to the tight deadline for completion of the Drought Plan, the WRC was not able to fully explore all of the intricacies related to application of SPI values. These issues should be considered as future follow-on work items to be discussed at the next WRC meeting.

In the following section, an attempt was made to create a preliminary drought-stage characteristic (i.e. “trigger”) table for each task force committee. As mentioned above, the upcoming deadline did not allow the time necessary to test the validity of these indices as they apply to the different stages of drought. The tables should be considered and reviewed as a “first cut” effort toward development of a practical, and hopefully, reliable trigger mechanism for drought mitigation and response. The proposed SPI based index is open to review and modification by the WRC and other task force committees. As more information becomes available to the WRC, further refinement and improvement to this index approach is expected. A future goal may include narrowing each table to specific geographic region and type of use sector.

Proposed Drought Stage Characteristics

Each Drought Task Force is comprised of members from similar use sectors from each of the islands. If you assume these use sectors are generally affected in similar ways under similar drought conditions, the case can be made that common drought indicators (depending on location or geography) can and should be applied. Under this scenario, consistent application of the proposed sector based drought indices may be deemed appropriate and will serve to simplify implementation of response and/or mitigation measures by each Task Force Committee. Drought Stage Characteristics described below serve as descriptors that define the different stages of drought for each sector. These descriptors include SPI, duration, and other drought-related indices such as reservoir levels, stream flows, ground water levels, crop and grazing land

loss, fire danger ratings, and so forth. The type of descriptors may vary according to the use sector being addressed. It is important to note that different locations may require further modification or refinement of descriptors.

Water Supply Task Force

The Water Supply Task Force consists of members from the municipal water supply agencies, private water system operators, CWRM, DOH-SDWB, agriculture water system operators, and major landowners (Representation from the military should be added to this committee.). In the case of water supply during drought, proposed drought stage characteristics (Table 6) is based upon a 12-month SPI within watershed and demand regions. This index is coupled with existing ground water levels, ground water chloride concentrations, surface water and ditch flows, established municipal water supply triggers, and storage reservoir levels. (Note: the WRC may opt to modify the SPI to use 18 or 24-month SPI)

Table 6: Proposed Drought Stage Characteristics for the Water Supply Sector

Drought Stage	General Characteristics (SPI Values, % of time, etc.)
Normal	<ol style="list-style-type: none"> 12-month SPI .99 to –.99 ground water levels normal
Stage 1	<ol style="list-style-type: none"> 12-month SPI –1.0 to –1.49 for two consecutive months water supply declares Low Groundwater Conditions “Caution” (if applicable)*
Stage 2	<ol style="list-style-type: none"> 12-month SPI between –1.5 and –1.99 for two consecutive months water supply declares Low Groundwater Conditions “Alert” (if applicable)
Stage 3	<ol style="list-style-type: none"> 12-month SPI less than –2.0 for two consecutive months water supply declares Low Groundwater Conditions “Critical” (if applicable)

- See Appendix for detailed description of Honolulu BWS Low Groundwater Conditions

Agriculture and Commerce Task Force

The Agriculture and Commerce Task Force is comprised of members from the ranching, farming, golf course, and aquaculture sectors. Members also include state and federal agriculture agencies, Hawaii Association of Conservation Districts, Hawaii Farm Bureau, and Hawaii Cattlemen’s Council. Under the proposed trigger methodology (see table 7), principle drought stage characteristics include a 3-month SPI, existing surface water and ditch flow levels, soil moisture, increased irrigation demands, crop loss and livestock statistics. (As noted above and for sectors to follow, the proposed approach needs to be further tested and validated against historical information. Review by the WRC membership may warrant additional modification of the prescribed characteristics.)

Table 7: Proposed Drought Stage Characteristics for the Agriculture and Commerce Sector

Drought Stage	General Characteristics (SPI Values, % of time, etc.)
Normal	<ol style="list-style-type: none"> 1. 3-month SPI .99 to -.99 2. normal surface water flows 3. reservoir storage above 75% capacity
Stage 1	<ol style="list-style-type: none"> 1. 3-month SPI -1.0 to -1.49 for two consecutive months 2. 30-day surface water low flow value \leq 10-year but \geq 20-year recurrence interval 3. reservoir storage below 75% capacity
Stage 2	<ol style="list-style-type: none"> 1. 3-month SPI -1.5 to -1.99 for two consecutive months 2. 30-day surface water low flow value \leq 20-year but \geq 50-year recurrence interval 3. reservoir storage below 50% capacity
Stage 3	<ol style="list-style-type: none"> 1. 3-month SPI -2.0 or less for two consecutive months 2. 30-day surface water low flow value \leq 50-year recurrence interval 3. reservoir storage below 25% capacity

Environment, Public Health and Safety Task Force

The Environment, Public Health and Safety Task Force is made up of members from the state and county fire suppression agencies, State and County Civil Defense, and the State Fire Council. (Membership for each of the Task Forces may need to be revised to include other impacted and/or response-related agencies.) The principal drought stage characteristics proposed (see table 8) for this sector are a 3 -month SPI, fire danger ratings, fire weather index, fuel loading index, and soil moisture.

Table 8: Proposed Drought Stage Characteristics for the Environment, Public Health and Safety Sector

Drought Stage	General Characteristics (SPI Values, % of time, etc.)
Normal	<ol style="list-style-type: none"> 1. 3-month SPI .99 to -.99 2. normal surface water flows
Stage 1	<ol style="list-style-type: none"> 1. 3-month SPI -1.0 to -1.49 for two consecutive months 2. Fire Danger Rating of x (?)
Stage 2	<ol style="list-style-type: none"> 1. 3-month -1.5 to -1.99 for two consecutive months 2. Fire Danger Rating of x (?) 3. issuance of no-burn warnings 4. municipal water supply transports water to rural water-catchment areas
Stage 3	<ol style="list-style-type: none"> 1. 3-month less than -2.0 for two consecutive months 2. Fire Danger Rating of x (?) 3. declaration of park & trail closure

Drought Forecasting

Current drought-forecasting products by the Climate Prediction Center are not very useful to the Water Resources Committee. Long-lead forecasts using El Nino/La Nina indicators show some promise. The group agreed that better forecasts are needed for Hawaii than the existing products issued by CPC (due to low forecast skill and inappropriate forecast locations). Mitigation activities and hence the greatest degree of resource/health/safety protection can be triggered based on a forecast. In addition to the rainfall outlook, these forecasts must convey the degree of uncertainty of the forecast. For example, onset of a strong El Nino will likely result in a drought forecast. The group also needs to communicate to the public that confidence of a drought in this situation is high. Conversely, the onset of a La Nina may result in a wetter than normal forecast with a lower confidence. These types of forecast capabilities require further local research and should be funded as part of our drought plan.

When developing new long-lead drought forecast models it is important to take into account both windward and leeward locations on each island. Differences in rainfall have been apparent during the last few years. In an operational setting, it is necessary to consider past, current, and "future" conditions before making any advice to the State Drought Coordinator in an attempt to minimize the possibility of a false alarm. Any drought forecast should not be expressed in a deterministic form, but in a probabilistic sense (to express the uncertainty). The public needs to be aware that there is no such thing as a perfect forecast.

However, there will always be a need for indices such as the SPI based on observational data which applies to both the MITIGATION and RESPONSE phases. For example, when the SPI (or whatever index you use) indicates a mild drought, this can trigger activities to mitigate the effects of more severe droughts. Furthermore, until the uncertainty of forecasts is reduced, any index based on actual observational data will carry more weight; especially when trying to convince governmental entities to commit resources in a tight budget climate. The key to mitigating drought impacts is the early identification of conditions indicating an impending drought.

More research in this area of drought forecasting is warranted. Further advancements and reliability in forecasting will facilitate current efforts to implement more aggressive mitigation measures thereby hopefully reducing subsequent response actions in the event of an actual drought.

Data Submission and Assimilation

For each drought index and descriptor, there will be a lead organization. This organization will be responsible for calculating or determining the index or descriptor at the end of each month during normal (non-drought) conditions. The index or descriptor will be submitted to the chairperson of the WRC or posted on the organization's web site, where the information will be summarized in a monthly report. The monthly report will be posted on the HDC web site and distributed via fax and mail to interested parties. If a drought event is indicated, there may be a request for more frequent submission of information (if possible).

The report should be brief and concise. There should be a summary section where the current drought stage or condition is stated. The summary should also contain any short or long-term forecasts approved by the WRC. There should also be a data section showing the actual indices and descriptors. This may simply be links to other organization's web sites.

Drought Communication and Notification

The Water Resources Committee operates as the central core of the Hawaii State Drought Plan and is responsible for monitoring all available data pertinent to analyzing the current status and forecasted level of drought conditions in the State of Hawaii. Perhaps more importantly, is the role of the WRC to regularly communicate such information to the various Drought Task Forces. Such data would include, but not be limited to, climatological data, soil moisture readings, reservoir storage levels, ground water conditions, weather forecasts and other available information. A major responsibility of the WRC (comprised of water resource, agricultural and climate professionals) is to assess information, evaluate current and future drought conditions in the State, and to update the other task forces as to the current status level of drought in the State. These "triggers" under the Hawaii Drought Plan will be used to implement further actions by the other task forces (see Table 9).

Under the Drought Plan, the WRC will provide a quarterly updated report during normal non-event conditions. Reports will be cleared with the co-chairs of the Hawaii Drought Council prior to dissemination to other task force members, the general public or posting on any existing agency or future drought website. During periods of Stage 1 to Stage 3 drought conditions, more frequent reports (monthly/weekly) may be utilized to maintain up-to-date communications with the HDC, the Drought Task Forces, and the public. Meetings of the WRC will be held on a quarterly basis (more often as needed during periods of droughts) to review the status of current conditions and the outcomes/results of recent studies that may have been undertaken. In addition, the WRC should review and update current drought monitoring efforts and assess the need for additional plans or actions necessary to update committee members on forecasts or other issues related to drought. Conference calls and/or other informal communication means maybe used to communicate and provide information to the other Task Force committees. Issuance of public notifications will follow all legal and generally accepted means of communication currently utilized to inform key stakeholders and the general public.

Drought Task Force Response and Mitigation

The following tables are presented merely for illustrative purposes as to how proposed drought triggers might be applied for a given sector (i.e. Water Supply, etc.). Table 10 is intended to represent response/mitigation actions that may be implemented on a statewide basis. Whereas, Table 11 depicts a more regional (either island based or geographic based) approach toward implementation of those actions associated with the various stages of drought.

Table 9: Drought Communication Actions

<u>Drought Stage Levels</u>	<u>Water Resources Committee</u>	<u>Water Supply Task Force</u>	<u>Agriculture and Commerce Task Force</u>	<u>Environment, Public Health and Safety Task Force</u>	<u>Agency and Public Communication</u>
Normal	Monitor drought indices. Review available data for drought conditions or deteriorating conditions				Quarterly Report prepared by WRC and transmitted to HDC and DTF
Stage 1	Review available data for drought conditions or deteriorating conditions. Submit monthly report re drought conditions to all Drought Task Forces.	Review monthly reports and implement sector response measures, as appropriate. (Tables 10 & 11)	Review monthly reports and implement sector response measures, as appropriate.	Review monthly reports and implement sector response measures, as appropriate.	Issues Public Notice re Stage 1, “Caution Condition”. Notify DTF membership.
Stage 2	Review available data for drought conditions or deteriorating conditions. Submit monthly report re: drought conditions to all Drought Task Forces.	Review WRC monthly report, take appropriate mitigation and/or response actions. Prepare monthly report to HDC	Review WRC monthly report, take appropriate mitigation and/or response actions. Prepare monthly report to HDC	Review WRC monthly report, take appropriate mitigation and/or response actions. Prepare monthly report to HDC	Issue 2nd Public Notice re Stage 2, “Alert Condition”. Transmit DTF monthly reports to HDC
Stage 3	Review available data for drought conditions or deteriorating conditions. Submit monthly/weekly report re: drought conditions to all Drought Task Forces.	Review WRC monthly/weekly report, take appropriate mitigation and/or response actions. Prepare monthly/weekly report to HDC	Review WRC monthly/weekly report, take appropriate mitigation and/or response actions. Prepare monthly/weekly report to HDC	Review WRC monthly/weekly report, take appropriate mitigation and/or response actions. Prepare monthly/weekly report to HDC	Issue 3rd Public Notice re Stage 3, “Critical Condition”, News Releases, TV, and Radio spots. Transmit DTF weekly reports to HDC

Each task force was requested to develop a similar table assigning response and mitigation measures to each sector based activity. It is thus envisioned that each task force will, to the extent possible, tailor response actions to specific drought levels for specific categories within each sector. Evidence may show, however, that further “subdividing” of actions may not be practical across a particular sector. Based on the information to be derived in Phase 2, data should be inputted into table format for use by the HDC, the respective task forces, and other affected parties. The following tables are examples of the recommended sector-based assessments for response and mitigation actions.

Table 10: Example Table for Statewide Drought Task Force Response and Mitigation Actions

STATEWIDE Drought Task Force Response and Mitigation Actions:					
By Sectors (having highest vulnerability)	<u>Drought Stages</u>	<u>Response</u>	<u>Mitigation*</u>	<u>Responsible Entity</u>	<u>Communication Actions</u>
<i>Water Supply</i>	Stage 1				
	Stage 2				
	Stage 3				
Specific Impact Areas: <ul style="list-style-type: none"> ▪ Catchment System ▪ Municipal ▪ Private System ▪ Energy Production System ▪ Surface Water Supply ▪ Ground Water Supply ▪ Others 					
<i>Agriculture and Commerce</i>	Stage 1				
	Stage 2				
	Stage 3				
Specific Impact Areas: <ul style="list-style-type: none"> ▪ Crop Irrigation ▪ Ranching/Livestock ▪ Others 					
<i>Environmental, Public Health and Safety</i>	Stage 1				
	Stage 2				
	Stage 3				
Specific Impact Areas: <ul style="list-style-type: none"> ▪ Fire Suppression ▪ Emergency Water Supply ▪ Others 					

Table 11: Example Table for Regional Drought Task Force Response and Mitigation Actions

REGIONAL Drought Task Force Response and Mitigation Actions:					
By Sectors (having highest vulnerability)	<u>Drought Stages</u>	<u>Response</u>	<u>Mitigation*</u>	<u>Responsible Entity</u>	<u>Communication Actions</u>
<i>Water Supply</i>	Stage 1				
	Stage 2				
	Stage 3				
Specific Impact Areas: <ul style="list-style-type: none"> ▪ Catchment System ▪ Municipal ▪ Private System ▪ Energy Production System ▪ Surface Water Supply ▪ Ground Water Supply ▪ Others 					
<i>Agriculture and Commerce</i>	Stage 1				
	Stage 2				
	Stage 3				
Specific Impact Areas: <ul style="list-style-type: none"> ▪ Crop Irrigation ▪ Ranching/Livestock ▪ Others 					
<i>Environmental, Public Health and Safety</i>	Stage 1				
	Stage 2				
	Stage 3				
Specific Impact Areas: <ul style="list-style-type: none"> ▪ Fire Suppression ▪ Emergency Water Supply ▪ Others 					

V. DROUGHT ASSESSMENT AND RESPONSE

RISK ASSESMENT AND PLANNING

Drought risk management encompasses human, financial, economic, social, environmental, and political aspects. These various aspects often interact in complex ways. The extent and severity of impact will depend on the scale, intensity, and duration of the drought event. The basic objective of drought risk management is to minimize possible adverse outcomes within the constraints of the costs involved. Drought risks and associated impacts differ from situation to situation and requires an effective drought risk management strategy which includes:

- Effective information on which to base decisions;
- Appropriate policy, institutional, and other arrangements for needed assessments;
- Communication, and application of that information;
- Identification of an appropriate range of risk management tools for government and private decision makers; and
- Effective and consistent actions on the part of both government and private decision makers.

Some drought-related risks and corresponding impacts are described below:

Drought Risks

Financial/Economic

- Personal/farm business
- Local/regional economy
- National economy
- International

Environmental

- Biological, natural resource base

Social/Political

- Personal/family
- Political

Impacts

- Personal/family disposable income
- Capital Values
- Farm and non-farm incomes
- Local and regional adjustment
- National income
- Current account
- Structural adjustment
- Aid expenditures
- Native and domesticated animals, invasive species, vegetation losses, soils, water, de-watering of streams
- Physical and mental health
- Education and personal development
- Political pressures and policy uncertainties

Given the range, complexity, and interaction of drought-related risks, and the potential range of decision makers involved, an integrated, interdisciplinary approach is required to provide a rounded appreciation of the problem. The occurrence of multiple ecological issues at different

phases of a drought event requires close cooperation between entities having different technical specialties within relevant sciences, government and the private sector.

Drought is a real problem in the State of Hawaii and significant droughts affect some part of the State at least once every five years. One of the main problems associated with drought is Hawaii's limited water resources. It is realized that some parts of Hawaii may be approaching the limits of its water supply. In 25 years, the availability of ground water on Oahu may be totally committed, requiring the use of more costly alternatives such as reusing treated wastewater, treating surface water, and desalinization of brackish or ocean water. Growing water demands may lead to shortages of water and over pumping of major aquifer systems. Inadequate source development planning will result in short- and long-term impacts to existing water resources.

The major cause of droughts are lack of rainfall and lack of adequate available water supply in certain parts of the State (i.e., Hawaii and Maui). Increasing water consumption, which can not be met by rainfall, leads to shortages because water distribution systems in some cases are neither flexible nor sufficient to make up the shortfall without exercising extraordinary emergency actions and measures.

Droughts have been prevalent in the past and will continue to adversely affect the environment, businesses and the citizens of Hawaii, due to these sector's strong dependency on rainfall and lack of adequate available water supply and/or infrastructure. Historical patterns verify with certainty that Hawaii will suffer damaging droughts. While it is difficult to predict or estimate loss, it should be assumed that many sectors of the State of Hawaii are at risk and the loss potential is significant. Also, the need for economic growth and revitalization will place added pressure on the islands' limited water supply. Failure to take appropriate action could result in Hawaii not having sufficient quantity and quality of water resources to sustain future population and industrial growth. Since water is limited and the prediction of future rainfall cannot be adequately made, the effective management of water resources is critical. Also important is aggressive planning for alternative resources besides existing ground and surface water sources.

Risk assessments, current response mechanisms, and proposed/planned mitigation measures to reduce potential impacts of droughts for various sectors which have high probability of being affected are described in the tables 13 through 28 below.

ASSESSMENT BY SECTOR

Water Supply Sector

Table 12: Water Supply Sector Assessment for the Drinking Water Category

Sector: Water Supply		
Category: Drinking Water Areas of vulnerability in the Drinking Water category include the following areas: <ul style="list-style-type: none"> • Hawaii – South Kohala, Makapala, Niulii, Kukuihaele, Haina, Papaikou, Paukaa, Waiohinu, Naalehu, Pahala, Waimea (DHHL), Puna, Kahuku, Kau, South Kona • Kauai – Kokee, Waimea, Anahola (DHHL), Various County and Private Systems • Lanai • Maui – Upcountry, Keokea (DHHL), Kahikinui (DHHL) • Molokai – Hoolehua (DHHL) • Oahu * Other areas to be identified in Phase 2		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Ground water	<ul style="list-style-type: none"> • Implement conservation program as warranted by reservoir, rainfall, and consumption monitoring • Pursue development of new well sources and reservoirs • Utilize nearby existing USGS monitoring wells for emergency use only • Utilize nearby existing irrigation ditches with micro-filtration and initiate a public awareness program for consumption of treated non-potable water • Continue to support USGS well drilling program • Haul water by tankers as required • Promote an island-wide conservation program • Implement conservation program as warranted by monitoring pumping hours of deep well and booster pumps • Develop conservation agreements with large users • Increase storage capacity • Better water management for all users involved • Decrease demand by use of “gray water” • Communicate with all water users on decreasing surface source • Develop and implement contingency plans 	County Water Depts. DOH-SDWB DOA DHHL DLNR CWRM USGS State CD Private Water Purveyors
Surface water	<ul style="list-style-type: none"> • Increase storage capacity • Communication with all water users on decreasing surface source • Improve transmission system capabilities • Improve source and storage • Develop comprehensive watershed protection plans by public and private partnerships • Ensure minimal loss of water from transmission system • Decrease demand by use of “gray water” • Develop partnerships to resolve water transmission issues • Develop and implement contingency plans • Haul water by tankers as required 	County Water Depts. DOH-SDWB DOA DHHL DLNR CWRM USGS State CD Private Water Purveyors

Catchment water	<ul style="list-style-type: none"> Pursue access to alternative sources of water Utilize nearby existing USGS monitoring wells, if available, for emergency use only Increase storage capacity 	County Water Depts. Various Government Agencies Impacted Communities
Watershed degradation	<ul style="list-style-type: none"> Initiate educational programs Develop and implement comprehensive watershed protection plans by public and private partnerships Reforestation of upper lands Encourage community tree planting programs, with emphasis on native species 	DLNR NRCS Various Government Agencies Private Entities
Wells exhibiting high chloride levels or have a short recharge time with limited storage	<ul style="list-style-type: none"> Shut down impacted wells and use other wells to supply water to affected areas Develop replacement well sources If pumpage from other sources is limited because of extended drought conditions and/or aquifer levels are at a dangerously low level, implement mandatory restrictions on water use If pumpage from other sources is not available, institute mandatory water use restrictions and provide water wagons with instructions that water is only for health and safety purposes Prior to drought conditions, identify existing uses that would be impacted by high chlorides and identify and install improvements to blend water with more potable sources or to supplement distribution systems 	County Water Depts. CWRM DOH-SDWB
System failure due to main breaks or power loss	<ul style="list-style-type: none"> Identify those systems that are isolated and would be hardest impacted due to both drought and infrastructure failure and give priority to insuring that infrastructure is up-to-date and within standards. If power loss occurs, deploy emergency portable generators to impacted pump stations to insure availability of water Utilize sources outside of areas with storage capacity deficits to supplement the internal sources to insure that there is an adequate water supply 	County Water Depts. DOH-SDWB
Reduced storage capacity of system	<ul style="list-style-type: none"> If drought conditions persist beyond external sources ability to supplement internal sources, implement mandatory water use restrictions 	County Water Depts. DOH-SDWB
Reduced or no production from other utilities in the event water supply	<ul style="list-style-type: none"> Form working partnerships with other utilities to address supply problems/concerns in times of drought and develop emergency alternatives for insuring continued supply of water for operations that would impact public 	County Water Depts. Private Water Purveyors DOH-SDWB

Table 13: Water Supply Sector Assessment for the Farming Category

Sector: Water Supply		
Category: Farming Areas of vulnerability in the Irrigation category include the following areas: <ul style="list-style-type: none"> • Hawaii – South Kohala, Waiohinu, Naalehu, Pahala • Kauai – Kokee, Waimea, Various Private Systems • Lanai • Maui – Upcountry • Molokai * Other areas to be identified in Phase 2		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Water shortage	<ul style="list-style-type: none"> • Encourage improvement to DOA agricultural water systems • Encourage the implementation of best management practices for water conservation • Develop conservation agreements with large users • Promote the repair of existing plantation agricultural water system in coordination with NRCS, to ensure minimal loss of water from transmission systems (i.e., convert unlined ditches to pipelines) • Increase storage capacity • Develop additional water sources 	County Water Depts. DOA DHHL DLNR CWRM DOH NRCS Private Water Purveyors
Crop loss	<ul style="list-style-type: none"> • Refer farmers that have suffered crop loss to FSA for any emergency assistance 	Private Farmers FSA
System Maintenance	<ul style="list-style-type: none"> • Conduct an assessment of all existing irrigation systems and determine what systems should be maintained and/or restored • Develop laws, ordinances, and/or administrative rules that require landowners to maintain irrigation systems on their property • Create self-sustaining Irrigation Districts (similar to Agricultural Development Corporation) to operate and maintain irrigation systems • Inventory all existing unused surface water reservoirs to provide additional storage for irrigation • Urge county planning department to require landowners to maintain irrigation systems on their lands • Encourage NRCS and SWCDs to promote on-farm water conservation and irrigation water management practices during conservation planning. 	Private Farmers DOA DLNR CWRM

Table 14: Water Supply Sector Assessment for the Ranching/Dairy Category

Sector: Water Supply		
Category: Ranching/Dairy		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Reduced water supply and forage	<ul style="list-style-type: none"> • Promote the repair of abandoned plantation agricultural water system in coordination with NRCS • Initiate emergency forage program • Promote rangeland management and planning program • Relocation of livestock 	County Water Depts. DOA Private Ranchers Private Landowners NRCS

	<ul style="list-style-type: none"> • Provide standpipes for ranchers hauling livestock drinking water during droughts 	USDA DLNR SWCD Farm Bureau Coop. Ext. Service
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Table 15: Water Supply Sector Assessment for the Fire Protection Category

Sector: Water Supply		
Category: Fire Protection		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Reduced water supply	<ul style="list-style-type: none"> • Inventory unused surface water reservoirs and restore to use where appropriate • Develop surface water sources and storage reservoirs to meet increased demand for fire fighting • Reduce the spread of guinea grass into watershed areas. Control spread of agricultural lands also. Grass is very susceptible to wildfires • Improve road access to remote areas in State and private lands. 	DLNR DOFAW CWRM DOA County Fire Depts. County CD State CD FEMA Private Landowners DHHL

Agriculture and Commerce Sector

Table 16: Agriculture and Commerce Sector Assessment for the Aquaculture Category

Sector: Agriculture and Commerce		
Category: Aquaculture		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Water storage & distribution	<ul style="list-style-type: none"> • Each individual responds appropriately • Develop new wells • Access to county and district resource information • Incorporate private water systems into overall water distribution programs • Use of military surplus equipment to transport equipment and personnel to drought stricken areas • Develop state policies, rules and guidelines that encourage the use of reclaimed or recycled water • Develop and implement agricultural instruction programs promoting practices that conserve water 	DOA CWRM State CD DLNR FWDA DOH
Mental health	<ul style="list-style-type: none"> • Initiate FSA drought outreach program during early stages of drought • Local/State mental health agencies provide assistance • Develop educational programs • Develop public information programs on community stress 	DOA CWRM State CD SWCD FSA DOH
Employment losses	<ul style="list-style-type: none"> • Initiate federal assistance program, low interest state loans, Federal Crop Loss Programs (farming), Agriculture loans. • Extend state loan program • Develop state agricultural revolving fund • Establish state subsidies and improve federal programs • Defer state land lease rent and taxes • Establish new insurance programs for losses • Develop a Hawaii directory/guidebook on available, state and county financial support programs for drought 	DOA DLNR SWCD FSA
Water quality	<ul style="list-style-type: none"> • NRCS PL-566 program, EQIP program, EPA grants • Provide for emergency use of “gray water” and surface water • Streamline 401 & 404 permitting during emergency conditions • Better involvement in EPA programs 	DLNR SWCD FWDA NRCS DOH
Infrastructure	<ul style="list-style-type: none"> • Utilize the USDA-NRCS PL-566 program to evaluate regional agricultural water shortage problems and to plan and cost-share implementation of drought-mitigation projects. • Complete Agricultural Water Use and Development Plan • Development of cooperatives for current land users • Infrastructure acquisition by state • New agricultural development to better use facilities, reduce costs • Redevelopment of existing systems • Education and conservation programs 	DOA CWRM DLNR SWCD County Water Depts. FWDA NRCS

Table 17: Agriculture and Commerce Sector Assessment for the Farming Category

Sector: Agriculture and Commerce		
Category: Farming Areas of vulnerability in the Farming category, comprised of both irrigated and non-irrigated lands, include the following (by county): <ul style="list-style-type: none"> • Hawaii – Kohala, Kona, Kau, Hamakua, Waimea, Puna, Volcano, Waimea (DHHL) • Kauai – West Kauai • Lanai • Maui – Kula, Lahaina, Central Maui, Kahikinui (DHHL) • Molokai – Hoolehua (DHHL) • Oahu – Waianae, Haleiwa, Waialua, Kunia 		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Water storage & distribution	<ul style="list-style-type: none"> • Each individual responds appropriately • Develop new wells • Access to county and district resource information • Incorporate private water systems into overall water distribution programs • Use of military surplus equipment to transport equipment and personnel to drought stricken areas • Develop state policies, rules and guidelines that encourage the use of reclaimed or recycled water • Develop and implement agricultural programs promoting practices that conserve water 	DOA CWRM State CD DLNR FWDA DOH DHHL
Erosion & soil productivity	<ul style="list-style-type: none"> • Initiate NRCS/FSA, PL-566 programs, EQIP program, DLNR Forest Stewardship Program, State Tax Credit (farming) • Initiate educational programs • Develop soil suitability maps to identify high potential agriculture areas 	DOA SWCD FWDA FSA NRCS
Loss of biodiversity	<ul style="list-style-type: none"> • Each individual landowner participate in state tree planting programs, NRCS Forestry Incentives Program and Wildlife Habitat Incentives Program, DLNR Forest Stewardship Program • Promote wind break planting throughout agriculture areas • Initiate and sustain on-going tree planting programs 	DLNR SWCD NRCS
Mental health	<ul style="list-style-type: none"> • Initiate FSA drought outreach program during early stages of drought • Local/State mental health agencies provide assistance • Develop educational programs • Develop public information programs on community stress 	DOA CWRM State CD SWCD FSA DOH
Employment losses	<ul style="list-style-type: none"> • Initiate federal assistance program, low interest state loans, Federal Crop Loss Programs (farming), Agriculture loans. • Extend state loan program • Develop state agricultural revolving fund • Establish state subsidies and improve federal programs • Defer state land lease rent and taxes • Establish new insurance programs for losses • Develop markets that encourage the planting of drought resistant crops 	DBEDT DOA DLNR SWCD FSA

	<ul style="list-style-type: none"> • Crop diversity during drought (farming) • Develop a Hawaii directory/guidebook on available, state and county financial support programs for drought 	
Water quality	<ul style="list-style-type: none"> • NRCS PL-566 program, EQIP program, EPA grants • Provide for emergency use of “gray water” and surface water • Streamline 401 & 404 permitting during emergency conditions • Better involvement in EPA programs 	DLNR SWCD FWDA NRCS DOH
Invasive species	<ul style="list-style-type: none"> • Continue funding DOA state programs, private research, USDA programs, DLNR programs (i.e., miconia eradication) • Continue research to reduce alien species • Develop public education programs 	DOA CWRM DLNR SWCD County Water Depts. NRCS
Infrastructure	<ul style="list-style-type: none"> • Utilize the USDA-NRCS PL-566 program to evaluate regional agricultural water shortage problems and to plan and cost-share implementation of drought-mitigation projects. • Complete Agricultural Water Use and Development Plan • Development of cooperatives for current land users • Infrastructure acquisition by state • New agricultural development to better use facilities, reduce costs • Redevelopment of existing systems • Education and conservation programs 	DOA CWRM DLNR SWCD County Water Depts. FWDA NRCS
Fire hazard	<ul style="list-style-type: none"> • Disseminate information to affected public as soon as possible • Develop on-going information and education program • Inform public about early warning system to reduce economic losses 	DOA SCD DLNR SWCD NRCS
Department of Hawaiian Home Lands Agricultural Systems	<ul style="list-style-type: none"> • Develop partnership with local agricultural water purveyors • Develop new/alternative sources • Develop public education programs regarding rangeland management, permanent storage and distribution systems • Increase storage capacity of existing systems 	DHHL DOA

Table 18: Agriculture and Commerce Sector Assessment for the Golf Course Category

Sector: Agriculture and Commerce		
Category: Golf Course		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Water storage & distribution	<ul style="list-style-type: none"> • Each individual responds appropriately • Develop new wells • Access to county and district resource information • Incorporate private water systems into overall water distribution programs • Use of military surplus equipment to transport equipment and personnel to drought stricken areas • Develop state policies, rules and guidelines that encourage the use of reclaimed or recycled water • Develop and implement agricultural programs promoting 	DOA CWRM State CD DLNR FWDA DOH County Water Depts. Private Water Purveyors County Wastewater

	practices that conserve water	Depts. Private Wastewater Purveyors
Erosion & soil productivity	<ul style="list-style-type: none"> Initiate educational programs Develop soil suitability maps to identify high potential agriculture areas 	DOA SWCD FWDA
Loss of biodiversity	<ul style="list-style-type: none"> Promote wind break planting throughout agriculture areas Initiate and sustain on-going tree planting programs 	DLNR SWCD
Animal & plant health	<ul style="list-style-type: none"> Better water and shade, provide more tree planting projects in agricultural areas (farming) Educate public on adverse impacts of drought 	DOA DLNR SWCD
Mental health	<ul style="list-style-type: none"> Initiate FSA drought outreach program during early stages of drought Local/State mental health agencies provide assistance Develop educational programs Develop public information programs on community stress 	DOA CWRM State CD SWCD DOH
Employment losses	<ul style="list-style-type: none"> Initiate federal assistance program, low interest state loans, Federal Crop Loss Programs (farming), Agriculture loans. Extend state loan program Develop state agricultural revolving fund Establish state subsidies and improve federal programs Defer state land lease rent and taxes Establish new insurance programs for losses Plant drought resistant crops Develop a Hawaii directory/guidebook on available, state and county financial support programs for drought 	DOA DLNR SWCD
Water quality	<ul style="list-style-type: none"> Provide for emergency use of “gray water” and surface water Streamline 401 & 404 permitting during emergency conditions Better involvement in EPA programs 	DLNR SWCD FWDA DOH
Invasive species	<ul style="list-style-type: none"> Continue funding DOA state programs, private research, USDA programs, DLNR programs (i.e., miconia eradication) Continue research to reduce alien species Develop public education programs 	DOA CWRM DLNR SWCD County Water Depts.
Infrastructure	<ul style="list-style-type: none"> Utilize the USDA-NRCS PL-566 program to evaluate regional agricultural water shortage problems and to plan and cost-share implementation of drought-mitigation projects. Complete Agricultural Water Use and Development Plan Development of cooperatives for current land users Infrastructure acquisition by state New agricultural development to better use facilities, reduce costs Redevelopment of existing systems Education and conservation programs 	DOA CWRM DLNR SWCD County Water Depts. FWDA

Table 19: Agriculture and Commerce Sector Assessment for the Ranching/Dairy Category

Sector: Agriculture and Commerce		
Category: Ranching/Dairy Areas of vulnerability in the Ranching/Dairy category include the following areas (by county): <ul style="list-style-type: none"> • Hawaii – Kohala, Kona, Kau, Hamakua, Waimea • Maui – Kula, Ulupalakua • Molokai • Oahu – Waianae 		
Impacts	Response and Mitigation Actions	Response Agency
Water storage & distribution	<ul style="list-style-type: none"> • Develop new wells • Access to county and district resource information • Incorporate private water systems into overall water distribution programs • Use of military surplus equipment to transport equipment and personnel to drought stricken areas • Develop state policies, rules and guidelines that encourage the use of reclaimed or recycled water • Develop and implement agricultural programs promoting practices that conserve water 	DOA CWRM State CD DLNR FWDA DOH Private Entities County Water Depts. Private Water Purveyors
Lack of feed	<ul style="list-style-type: none"> • Develop new wells • Access to county and district resource information • Incorporate private water systems into overall water distribution programs • Use of military surplus equipment to transport equipment and personnel to drought stricken areas • Develop state policies, rules and guidelines that encourage the use of reclaimed or recycled water 	DLNR SWCD FSA DOA DOH CWRM Private Water Purveyors Private Entities
Erosion & soil productivity	<ul style="list-style-type: none"> • Initiate NRCS/FSA, PL-566 program, EQIP program, DLNR Forest Stewardship Program, State Tax Credit (farming), and NRCS grazing land management assistance programs addressing soil erosion, soil productivity, pasture health, animal health, invasive species and overall drought response • Initiate educational programs • Develop soil suitability maps to identify high potential agriculture areas 	DOA SWCD FWDA FSA NRCS
Loss of biodiversity	<ul style="list-style-type: none"> • Each individual landowner participate in state tree planting programs, NRCS Forestry Incentives Program and Wildlife Habitat Incentives Program, DLNR Forest Stewardship Program • Promote wind break planting throughout agriculture areas • Initiate and sustain on-going tree planting programs 	DLNR SWCD NRCS
Animal & plant health	<ul style="list-style-type: none"> • Better water and shade, provide more tree planting projects in agricultural areas (farming) • Educate public on adverse impacts of drought 	DOA DLNR SWCD
Mental health	<ul style="list-style-type: none"> • Initiate FSA drought outreach program during early stages of drought • Local/State mental health agencies provide assistance • Develop educational programs • Develop public information programs on community stress 	DOA CWRM State CD SWCD FSA DOH

Employment losses	<ul style="list-style-type: none"> Initiate federal assistance program, low interest state loans, Federal Crop Loss Programs (farming), Agriculture loans. Extend state loan program Develop state agricultural revolving fund Establish state subsidies and improve federal programs Defer state land lease rent and taxes Establish new insurance programs for losses Develop a Hawaii directory/guidebook on available, state and county financial support programs for drought 	DOA DLNR SWCD FSA
Water quality	<ul style="list-style-type: none"> NRCS PL-566 program, EQIP program, EPA grants Provide for emergency use of “gray water” and surface water Streamline 401 & 404 permitting during emergency conditions Better involvement in EPA programs 	DLNR SWCD FWDA NRCS DOH
Invasive species	<ul style="list-style-type: none"> Continue funding DOA state programs, private research, USDA programs, DLNR programs (i.e., miconia eradication) Continue research to reduce alien species Develop public education programs 	DOA CWRM DLNR SWCD County Water Depts. NRCS
Infrastructure	<ul style="list-style-type: none"> Utilize the USDA-NRCS PL-566 program to evaluate regional agricultural water shortage problems and to plan and cost-share implementation of drought-mitigation projects. Complete Agricultural Water Use and Development Plan Development of cooperatives for current land users Infrastructure acquisition by state New agricultural development to better use facilities, reduce costs Redevelopment of existing systems Education and conservation programs 	DOA CWRM DLNR SWCD County Water Depts. FWDA NRCS

Table 20: Agriculture and Commerce Sector Assessment for the Silviculture Category

Sector: Agriculture and Commerce		
Category: Silviculture		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Erosion & soil productivity	<ul style="list-style-type: none"> Initiate NRCS/FSA, PL-566 program, EQIP program, DLNR Forest Stewardship Program, State Tax Credit (farming) Initiate educational programs Develop soil suitability maps to identify high potential agriculture areas Develop and implement agricultural programs promoting practices that conserve water 	DOA SWCD FWDA FSA NRCS
Loss of biodiversity	<ul style="list-style-type: none"> Each individual landowner participate in state tree planting programs, NRCS Forestry Incentives Program and Wildlife Habitat Incentives Program, DLNR Forest Stewardship Program Promote wind break planting throughout agriculture areas Initiate and sustain on-going tree planting programs 	DLNR SWCD NRCS

Animal & plant health	<ul style="list-style-type: none"> Better water and shade, provide more tree planting projects in agricultural areas (farming) Educate public on adverse impacts of drought 	DOA DLNR SWCD
Mental health	<ul style="list-style-type: none"> Initiate FSA drought outreach program during early stages of drought Local/State mental health agencies provide assistance Develop educational programs Develop public information programs on community stress 	DOA CWRM State CD SWCD FSA DOH
Employment losses	<ul style="list-style-type: none"> Initiate federal assistance program, low interest state loans, Federal Crop Loss Programs (farming), Agriculture loans. Extend state loan program Develop state agricultural revolving fund Establish state subsidies and improve federal programs Defer state land lease rent and taxes Establish new insurance programs for losses Develop markets that encourage the planting of drought resistant crops Crop diversity during drought (farming) Develop a Hawaii directory/guidebook on available, state and county financial support programs for drought impacted businesses. 	DBEDT DOA DLNR SWCD FSA
Water quality	<ul style="list-style-type: none"> NRCS PL-566 program, EQIP program, EPA grants Provide for emergency use of “gray water” and surface water Streamline 401 & 404 permitting during emergency conditions Better involvement in EPA programs 	DLNR SWCD FWDA NRCS DOH
Invasive species	<ul style="list-style-type: none"> Continue funding DOA state programs, private research, USDA programs, DLNR programs (i.e., miconia eradication) Continue research to reduce alien species Develop public education programs 	DOA CWRM DLNR SWCD County Water Depts. NRCS
Fire hazard	<ul style="list-style-type: none"> Disseminate information to affected public as soon as possible Develop on-going information and education program Inform public about early warning system to reduce economic losses Develop a process to apply for NRCS Emergency Watershed Protection program to restore vegetation and reverse watershed impairment following major fires 	DOA SCD DLNR SWCD NRCS

Environment, Public Health and Safety Sector

Table 21: Environment, Public Health and Safety Sector Assessment for the Wildland Fire Category

Sector: Environment, Public Health and Safety		
Category: Wildland Fire Areas of vulnerability in the Wildland Fire category include the following areas (by county): <ul style="list-style-type: none"> • Hawaii – Kona, Ka’u, South Kohala • Kauai – Hanapepe, Barking Sands, Kokee, Koloa • Lanai • Maui –Maalaea, Napili, Kihei, Wailea, Poli Poli • Molokai – (South, West) • Oahu – Nanakuli, Makaha, Mililani, Schofield, Waialua, Mokuleia, Aina Haina, Hawaii Kai, Makakilo, Ewa Plains * Other areas to be identified in Phase 2		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Accessibility	<ul style="list-style-type: none"> • Under normal fire events and workload, utilize existing fire suppression mechanisms of local, state, military and federal assets • Provide additional helicopter assets during critical drought periods 	DOFAW State CD County CD County Fire Depts. HARNG
Reduced water supply	<ul style="list-style-type: none"> • Utilize local government and private water tenders • Limit the use of salt water in suppression activities • Consider fire fighting needs when upgrading water systems • Inventory water sources statewide and seek agreements to maintain these water sources • Develop a policy for the use of salt water for fire fighting 	DOFAW County Public Works County Planning Dept. County Fire Depts. County Water Depts. State Highways Div. CWRM
Fuel loading	<ul style="list-style-type: none"> • Under normal workload, exercise thinning, pruning, grazing, and limited use of prescribed fire • Expand grazing program 	DOFAW Private Ranchers U.S. Army
Fire fighting resources	<ul style="list-style-type: none"> • Utilize existing fire suppression mechanisms of local, state, military, and federal assets • Modernize fire fighting agencies with new or specialized equipment to the extent fiscally possible • Purchase all-terrain fire fighting vehicles such as humvees. Acquire supplemental equipment such as pumps, hoses, and water buckets • Investigate the feasibility of purchasing new and innovative technology that would enhance the capability of fire response agencies • Acquisition of communications gear (air and ground) to ensure proper lines of communication are always available during fire suppression activities 	DOFAW County Fire Depts. State CD County CD U.S. Army Federal Fire Dept. HARNG Private Entities

Table 22: Environment, Public Health and Safety Sector Assessment for the Wildland/Urban Interface Areas Category

Sector: Environment, Public Health and Safety		
Category: Wildland/Urban Interface Areas		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Urban development	<ul style="list-style-type: none"> Conduct education outreach (i.e., fire prevention program, distribute brochures on “fire-proofing” homes in the interface) Establish a fire code/ordinance for homes in the wildland/urban interface Develop agency policy on dealing with wildland/urban interface problems 	DOFAW County Fire Depts. State Fire Council
Fuel loading	<ul style="list-style-type: none"> Conduct an aggressive campaign to reduce fuel in high threat areas Remove vegetation and other combustible materials around homes and business structures Study the feasibility of constructing and maintaining permanent fire breaks in high threat areas to prevent the spread of fires when they occur Construct fire roads into remote, high threat areas Conduct controlled burn activities in high threat areas Construct reservoirs or holding basins to store water for fire fighting purposes Identify and map the areas where excess fuel constitute a significant threat for fire Conduct assessments of fuel loads in high risk areas on an annual basis 	DOFAW County Fire Depts. State Fire Council

Table 23: Environment, Public Health and Safety Sector Assessment for the Environment Category

Sector: Environment, Public Health and Safety		
Category: Environment		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Terrestrial	<ul style="list-style-type: none"> Conditions: Wildlife will be affected and hunters will be restricted in high priority areas Emphasize public education programs to address hunting restrictions during drought periods 	DLNR DOFAW
Aquatic	<ul style="list-style-type: none"> Conditions: Fish habitat conditions may deteriorate and low stream/reservoir levels will restrict fishing opportunities 	DLNR DOFAW

Table 24: Environment, Public Health and Safety Sector Assessment for the Public Health Category

Sector: Environment, Public Health and Safety		
Category: Public Health		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Air Quality	<ul style="list-style-type: none"> Dust in high impact areas 	DOH-Clean Air Branch
Drinking Water Quality	<ul style="list-style-type: none"> 	DOH-SDWB
Water Quality Effluent	<ul style="list-style-type: none"> 	DOH-Waste Water Branch

MITIGATION MEASURES

Mitigation can be defined as actions or activities that reduce the degree of long-term risk and consequently the costs of responding to drought. It is often associated with actions taken after the facts to remedy damage caused by human or natural disturbances.

Drought mitigation comprises a broad range of proactive measures. “Risk management” using a proactive approach to drought management is a better mitigation tool than the normal reactive or “crisis management” approach. The key element to reducing impacts of drought on individuals, communities, and the environment is a coordinated drought preparedness program. If progress is to be made in improving our ability to manage drought, it will be the result of an integrated approach within and between levels of government, involving regional organizations and the private sectors where appropriate.

Drought preparedness and public education should be a continuing process and a key component of a comprehensive water management program. An effective drought mitigation plan as a minimum should include, (1) an analysis of past, current and projected water demand, instream flow needs for appropriate ecosystem protection, water availability, and (from these) potential water shortages; (2) a description of how shortages would be met (for example: increased supply, leak detection/elimination, water use efficiency, demand management) and an estimate of associated costs; (3) a description of interagency/intergovernmental coordination and public participation ; and (4) consideration of social and economic factors.

The recommended mitigation actions are clustered into several primary areas, from monitoring and assessment programs to the development of drought contingency plans. Many of the mitigative programs implemented by different states during recent droughts can be characterized as emergency or short-term actions taken to alleviate the crisis at hand. Other activities, such as legislative actions, drought plan development, and the development of water conservation and other public awareness programs are considered as actions with a longer-term emphasis. In all cases, mitigation must be cost-effective and its effective application must be long-term.

Mitigation is maximized when there are strong commitments for implementing a variety of strategies. In Hawaii, at present, all of the counties and the State are actively involved with drought mitigation projects such as seeking alternative water sources, imposing conservation practices as required, and improving water systems. For the State of Hawaii, the basic drought mitigation recommendations include:

More Comprehensive/Integrated Planning

Integrating drought planning is critical to making strategic decisions on the use and development of water resources. With a limited availability of water in certain areas of the state and increasing demands for water, existing resources may not be sufficient to handle a longer-term crisis situation. Thus as a mitigative measure, development of alternative water sources and fair and equitable distribution of such water is essential for the state. To achieve that, there is a need for coordinated land-use and water resource planning. This will guide the policy and decision-

makers in insuring that adequate water is available for present and future uses. In order to guide decisions on the availability and use of water resources, there is a growing need for compiling baseline information and demand projections. Also it is important that all levels of government be involved in the protection and development of water resources and they must coordinate their activities to eliminate duplication. The U.S. Army Corps of Engineers may conduct water supply and demand studies on a 50/50 cost reimbursable basis with State of Hawaii agencies under the Planning Assistance to the State program. However, it depends on the funding availability. NRCS can conduct a Cooperative River Basin Study to inventory land and water resources, evaluate the resource capabilities and concerns, and suggest alternative ways of managing the resources. This program is 100-percent federally funded. The lead agencies for the above activities are proposed to be federal, state and county governments.

Development of New or Alternative Water Sources

It is acknowledged that, when some areas in the counties of Hawaii and Maui experience below normal rainfall combined with the inflexible nature of existing water distribution systems, this results in water shortages. Accordingly, it is almost impossible to meet the water consumption demand without employing emergency measures. Also in some areas of the State, water from existing sources are limited and therefore, the search for new sources or investigation of feasible alternative sources must be explored. This could be achieved by developing single source systems, single combination systems, in several areas on the Big Island. Development of alternative sources such as wastewater reuse, surface water treatment, and desalting brackish or ocean water and construction of reservoirs are also recommended planning options. The county and state governments will be the lead and supporting agencies respectively, and funding sources may include State General Funds and Federal Mitigation Funds.

Water Conservation Practices

A feasible water conservation program should be a part of every state and county planning process. To ensure the availability of an adequate supply of water throughout the year, appropriate and wise use of available potable and non-potable water for private, municipal, industrial, agricultural, and military purposes during the dry and/or summer months is an important issue. Recommendations to develop and establish water conservation program should include, but not be limited to: (a) Develop a plan or plans to implement water restriction practices, voluntary and mandatory, if a drought is either imminent or exists; (b) Inform the public on water conservation measures at community events and through the schools; (c) Develop a media campaign to solicit public support and cooperation for the effective and prudent use of water; (d) Solicit voluntary cutback of consumption from large users; (e) Continue or develop incentive programs such as rebates for installing water saving fixtures and free inspection to identify leaking toilets and plumbing fixtures, (f) Reduce water supply system unaccounted for water due to system leakage and metering problems, (g) Support of water-conserving irrigation systems, irrigation water management practices, and other water conservation practices, such as windbreaks and cover crops. The lead and supporting agencies for these activities are county governments and FEMA respectively. The funding sources may

include State and County General Funds and Federal Mitigation Funds.

Public Information and Outreach

A key element in successful drought preparedness is public education. The examples of successful public education efforts identify development and implementation of coordinated public and school education programs, including workshops, newsletters, public service announcements, press releases, town hall meetings, school curricula, bill stuffers for utilities, and interactive participatory decision-making processes. These techniques and others provide communication links among organizations that provide assistance and the people that they serve. They also help increase awareness of the value of preparedness and planning to reduce costly impacts of droughts.

Public education/awareness will provide opportunities for the general public of the State of Hawaii to become involved and invested in drought-related decisions leading to greater self-reliance and self-determination. Public education also emphasizes local solutions based on consideration of all affected entities and related issues, including legal, economic, geographic, climate, religious, cultural, fairness and equity issues; and environmental concerns. These opportunities, however, are lost where people are not sufficiently trained to engage in drought planning or lack adequate technical assistance to do so.

Hands-on training and technical assistance programs can help formulate and implement plans to incorporate drought planning and mitigation processes. Such programs can help farmers in Hawaii decide whether to include drought-resistant crops, on-farm wells, crop insurance, conservation systems, restoration of wetlands and wildlife habitat, and other important factors into their risk-management strategies. They can help farmers implement water management practices and gain a better understanding of the soils and climate conditions in their areas and the types of crops and plants suitable to mitigating adverse changing conditions. Such assistance can also help them understand (and plan for) complicated marketing options and other methods to manage risks.

Training and technical assistance programs can also help Hawaii communities as they determine their own priorities for incorporating drought concerns, protection of environmental resources, and land-use and community planning into comprehensive water management plans aimed at ensuring safe and available adequate drinking water for both urban and rural areas. Government agencies and stakeholders still may need training and technical assistance in gathering drought-related information, devising drought impact-reduction strategies, and preparing public education and involvement campaigns to develop locally appropriate solutions. State climatologists and researchers in university drought-related programs, as well as federal experts, are potential sources for training assistance.

A number of potential planned actions to achieve effective mitigation are described below.

POST-DROUGHT EVALUATION

The State of Hawaii should plan to have a Post-Drought Evaluation Team to address the following questions as a part of the evaluation process:

1. Was the drought plan followed?
2. Were the actions taken and measures implemented effective in mitigating the impact of the drought? Which actions and relief measures were effective and which were not?
3. Should the plan have included other actions or assistance measures?
4. Did aid reach all affected groups in the stricken area? If not, why not? How were the target groups for aid identified?
5. Were the measures timely in relation to the events of the drought period?
6. Was it possible to correct errors during the emergency?
7. What financial and human resources were allocated to the relief effort? Where did the resources come from and how were they controlled?
8. How efficient was the logistical support and the available infrastructure? What obstacles were encountered that reduced the efficiency of the response?
9. How effective was the coordination of county, state, and federal response efforts? How did this cooperation affect the flow of information or assistance?
10. Was media coverage accurate and realistic in providing details of the event? What kinds of media were involved? What role did they play in the emergency?

The following questions are examples of a post-drought evaluation review to assist in evaluating drought response. Many of them are modeled after questions developed by the International Drought Information Center.

11. What unit of your agency was active in the water shortage response? How was this decided?
12. What are the normal responsibilities of this section? Has drought response been incorporated in the operations of this unit?
13. How were upper level managers kept informed of activities? How often they were informed?
14. What are the responsibilities of your agency in case of drought-related water

- shortages? What information or cooperation do you need from other agencies to carry them out? Was this communication and activity adequate? How could it be improved?
15. What other agencies did you report to during the drought? What media were used and with what frequency? Name of person responsible. Was the result satisfactory?
 16. What other agencies reported to yours? What media were used and with what frequency? Who was responsible? Was the result satisfactory?
 17. Were the actions taken by your agency effective in mitigating the impacts of drought? Which measures were effective and which were not? What activities should be added?
 18. What financial and human resources were allocated to the relief effort? Where did the resources come from and how were they controlled? How much time and money were involved?
 19. Provide any impact estimates prepared by your agency. Include costs, losses, and gains from the drought, in terms of dollars and/or the impact on the environment and resource base.
 20. Any other recommendations or comments?

Pricing

Pricing is another area of planned actions for drought mitigation. The costs of running a utility during a drought (emergency hook-ups, publicity, etc.) will increase, while revenues from water sales will decrease (as consumers use less). Officials should consider a rate schedule to generate revenues during drought conditions, when users are likely to be more receptive to such measures. Systems governed by the Public Utility Commission (PUC) must have its approval to change rates or rate schedules. Although conservation pricing is important, it will not effectively reduce water use unless used in conjunction with an educational effort.

Measures that can be used on any system:

- Seasonal rate: Higher rate during months of peak demands. Effective when shortages and peak demand months coincide and must be adjusted so that rates are equitable per user.
- Drought surcharge: Flat surcharge, regardless of use
- Increasing block (progressive rate scale): Higher rate charged per unit as total use increases. Rate rises in steps per block of volume.
- Measures that can be used on metered systems:

- Conservation discount: Discount for reducing use below required conservation level.
- Excess use charge: Higher rate for use above a fixed maximum.
- Penalty charge (in conjunction with rationing): Penalty charges should be high.
- Flat charge: For use above a certain amount (baseline), with an increase for subsequent offenses. The baseline maximum use figure which is one per capita (if population records are up to date); or two per household. Administering baseline maximum programs that vary per household is difficult.
- Disconnect/reconnect charge: Charge for ceasing and/or reinstituting service after rationing provisions have been violated.

Alternatives

The implementation of alternative strategies and source developments prior to the occurrence of drought conditions is a practical mitigation tool. These planned actions are a combination of institutional, scientific, technical, social, political, local, state and federal options and are listed in priority order.

- Assess available water volumes, clean mud and silt out and enlarge existing reservoirs to increase storage capacity.
- Gauge streams and reservoirs to determine storage figures and find a “trigger point” to require conservation and rationing.
- Conduct drilling programs to determine the groundwater storage capacity of nearby stream alluvium.
- Construct “gallery wells” or horizontal, screened interceptors in the thin alluvium and conventional wells in the thicker alluvium.
- Determine “trigger points” using long-range weather predictions to start mandatory conservation measures.
- Plan well in advance for the interconnection of public water systems that have supplies adequate for drought conditions.
- Make detailed plans and set up the mechanisms for temporary (or permanent) pipelines to furnish water to water-short communities for both short-term and long-term shortages. In all cases, the water supply source should be identified well in advance of drought.

- Set up mechanisms for hauling water by truck to supply communities in desperate water-shortage conditions.
- Establish “Conservation” rate structures which are triggered at a predetermined SPI or some other method determined by the state) to be applicable to the affected area.
- Establish agreements such as Memorandum of Understanding (MOU) with private reservoir owners or government agencies having operational control of reservoirs that could serve as water supply sources to furnish an agreed upon amount of water during drought emergencies. The means of transmitting set amounts of water and the level of water quality would have to be determined at the time of agreement. Any such agreement should be underwritten with the conservation measures mentioned in the previous alternative.
- Identify sites or locations for water loading stations for rural area water haulers.
- Prepare a long-term alternative of water system regionalization. This will mitigate the impacts of drought through construction of regional supplies, distribution and storage facilities, and water system consolidation.

Drought Report

Drought reporting is an effective tool for preparedness. The HDC may request that a Summary Drought Report be prepared during periods of significant drought activity. State and county agencies may be requested to submit summary reports describing drought-related assessments and response activities taken by that agency during this period. Reports should describe actions taken over the preceding months, including a list of drought management objectives for the year, planned actions to mitigate drought impacts, and a summary of any problems encountered and/or successes realized by the agency/organization.

Individual agency summaries shall be submitted to the State Drought Coordinator for incorporation with applicable federal agency reports. A final Summary Drought Report shall then be submitted to the HDC and should be used to review and evaluate agency responses, draft suggestions for legislative initiatives, and amend the state drought plan as needed.

COMMUNICATION

Successful implementation of the Hawaii Drought Plan depends in large part on the timely dissemination of clear and precise information to affected agencies and the public during and preceding periods of droughts. Communication Guidelines as such are needed to accomplish such efforts and are summarized below:

- Initial release of any drought status report or response information should be coordinated with the Office of the Governor through the Hawaii Drought Council.

- Drought press releases originating from the Office of the Governor will target the general public, media outlets, congressional delegations and affected federal, state, and county agencies.
- Drought-related information should be shared on a timely basis with all affected agencies. Dissemination of such information between agencies and with the general public should be coordinated with the Hawaii Drought Council. Coordination through the HDC will ensure timely notification of the Office of the Governor regarding critical drought-related information. Additionally, dissemination of drought information should focus on those individuals/organizations requiring assistance or other drought-related services.
- The dissemination of Drought Public Service Announcements for use by radio and television media in drought-affected counties should be coordinated with the Hawaii Drought Council. Additionally, pertinent drought-related information should be coordinated with the HDC prior to its posting on any website other than the Interim Hawaii Drought Website.

VI. IMPLEMENTATION PLAN

Implementation of the Hawaii Drought Plan is expected to be a dynamic process requiring government and private entities to take a variety of assessment and mitigative actions prior to and during periods of droughts. For example, local water or county officials may take specific planning or corrective actions to reduce high risk issues prior to a drought (i.e. develop a new water source for a community that is identified as high risk). At the same time a state agency may be developing new policy and guidelines to encourage greater water conservation measures or planning tools/processes to also reduce vulnerability. These types of proactive mitigation will reduce risk and lessen impacts during periods of droughts.

The Risk Assessment and Planning Section of this plan identified a variety of possible actions which different entities should plan, develop, and implement as resources and funding becomes available. Identified actions were prioritized so that decision makers (i.e., the Hawaii Drought Council, local government, stakeholders, etc.) can effectively allocate limited resources to reduce risk and vulnerability during periods of droughts. The importance of working as a team, knowing and sharing common goals, and striving to reach the same end point will ensure that the Hawaii Drought Plan is a success.

The following implementation plan is essential not only for the allocation of resources but is crucial to ensuring a coordinated and prioritized level of commitment on the part of government leadership and other stakeholders. It should be noted that the dynamic nature of this plan might result in priority changes over time. Additional data collection and analyses undertaken during Phase 2 may result in modification of existing and/or recommended response and mitigation measures. As further refinement of the Hawaii Drought Plan is undertaken, every effort should be made to ensure appropriate flexibility to meet changing environmental or leadership conditions.

PRIORITY IMPLEMENTATION ACTIONS

Based on each task force's assessment of sector-based issues, the following priority actions have been identified for immediate implementation:

1. Establish by Governor's Executive Order, the Hawaii Drought Council whose directive shall be to prepare and implement a state drought plan to coordinate and enhance current response measures and to complete implementation of priority mitigation actions to reduce the effects of drought impacts in Hawaii. The Executive Order should also establish a State Drought Coordinator (SDC) position to be assigned to the Commission on Water Resource Management for administrative purposes. The position should be established and operational by October 2000, and should be appropriately funded and used to support successful implementation of the Hawaii Drought Plan. The Hawaii Drought Council should also work with the State Legislature to determine the need for possible legislation to support the Governor's Executive Order and to address future funding requirements.

2. The HDC, in coordination with the drought task forces/committees, should identify (2-3) high priority areas and conduct a geographic-specific risk assessment and vulnerability analysis within the next 12 – 18 months. The study should include review of existing monitoring and data collection, assessment of sector-based vulnerability, response/mitigation limitations and possible solutions, and any other site-specific risk management analyses as may be needed. Based upon the results and analysis of the selected priority areas, seek to expand the risk assessment and vulnerability study to other priority areas in the state, subject to available funding.
3. Validate and refine proposed drought indices and triggers developed by the Water Resources Committee based upon correlation with historical data, past drought events, etc. for each water use sector (e.g., Water Supply, Agriculture and Commerce, and Environmental, Public Health and Safety). To the extent possible and in conjunction with trigger validation, assess and develop more effective measures for accurately predicting the onset of drought conditions prior to reaching Stage 1 drought conditions.
4. The HDC, in coordination with each county, should develop a prototype county drought plan. One county should be initially selected for development of the county drought plan component which should be immediately undertaken and completed within 12 months. The county drought component should be used to further define county/local responsibilities, the role of the county level drought committees, the interrelationship of county plans/committees to the state drought plan, and existing county response capability, procedures, and resources. The county plan should also identify high risk issues/areas and county specific mitigation measures to reduce drought impacts within the county. Based upon the results of the initial prototype county drought plan component, determine if additional county-specific drought plans should be developed for each county.
5. Seek appropriate funding to undertake and complete preparation of the Agricultural Water Use and Development Plan (AWUDP) component of the Hawaii Water Plan within the next 12 – 18 months.
6. Encourage military involvement in subsequent drought planning activities and incorporate military drought response/mitigation provisions within Phase 2 of the drought plan.
7. Develop policy allowing emergency access to (or seek funding to develop new) standby water sources and/or storage facilities in drought prone regions for public and private use during a declared drought emergency.
8. Consider new legislation for agricultural loans or grants covering drought impacts, damages, or losses, or similar emergency funding mechanism.

In addition to the priority action items discussed above, specific response/mitigation measures identified in Section V Drought Assessment and Response have been categorized into near-term

(12 – 18 months) and long-term (18 - 24 months) actions. The Hawaii Drought Council should undertake these items as part of Phase 2 of the drought plan in coordination with the completion of priority action times identified for immediate implementation.

WATER RESOURCES COMMITTEE

Near-Term Actions (12 – 18 months)

- Conduct risk and vulnerability assessments for each island.
- Develop more reliable drought forecasting capability.
- Identify existing data gaps and improve current data collection.
- Validate and refine proposed drought indices/triggers.
- Establish a State Drought Coordinator position to oversee plan implementation.

Long-Term Actions (18 – 24 months)

- Identify and prioritize critical monitoring sites and data collection requirements.
- Develop soil moisture data collection program.
- Develop SPI island maps in cooperation with the Pacific Disaster Center.
- Continue development of drought mitigation measures, including appropriate training and educational activities.

WATER SUPPLY TASK FORCE

Near-Term Actions (12 – 18 months)

- Establish a State Drought Coordinator position with adequate funding support to carry forward and implement recommended drought plan actions.
- Assess, clarify and coordinate, if necessary, county/local committee responsibilities during drought emergencies. Existing county response structure, procedures, available resources, etc. should be identified. Integration between existing county measures and recommended drought plan provisions should be further clarified or established as part of Phase 2 of the plan.
- Identify private water system issues and available response/mitigation measures.
- Test, validate, and refine proposed drought indices/triggers (e.g. SPI) for each sector and for each island.
- Subject to validation of drought triggers, develop specific sector-based and region-based response/mitigation measures for Drought Stages 1, 2, and 3.
- Seek funding to complete preparation of the Agricultural Water Use and Development Plan (AWUDP) by the DOA.
- Involve the military in subsequent drought planning activities.

Long-Term Actions (18 – 24 months)

- Clarify requirements for use of reclaimed water over safe drinking water sources. Initiate studies, as necessary, to investigate issues including but not limited to nitrate loading, increased salinity, etc.
- Develop a drought-related public education program and budget. Secure necessary funding to implement program.

AGRICULTURE AND COMMERCE TASK FORCE

Near-Term Actions (12 – 18 months)

- Develop policy allowing emergency access to (or seek funding to develop new) standby water sources and/or storage facilities in drought prone regions for public and private use during a declared drought emergency.
- Consider new legislation for agricultural loans or grants covering drought impacts, damages, or losses, or similar emergency funding mechanism.
- Allow a broader interpretation of, or revise, the eligibility requirements for assistance from the USDA Farm Services Agency or other federal agency disaster assistance programs during a drought to prevent problems currently experienced by farmers.
- Establish a drought coordinator position with adequate financial resources at the state level by sponsoring legislation in the 2001 session.
- Study the need for possible legislation at all levels of government to formalize the authority and responsibilities of the drought leadership structure together with an adequate source of funding.
- Analyze/clarify criteria and lines of authority that will kick in during times of drought before a drought impact occurs, and include forecasting/monitoring of climate patterns to provide ample warning on the approach of a potential drought.
- Seek funding to complete the Agricultural Water Use and Development Plan (AWUDP).
- Review criteria to determine Hawaii's ability to access feed assistance from the federal/state governments through bulk purchases and transportation subsidies to regions impacted by loss of range grass.
- Develop a policy to allow for lease rent waivers on state leases during a drought period.
- Clarify or develop procedures for use of unencumbered or vacant state or public land for temporary pasturing and allow cooperative pasturing.
- Improve and expand communication and public education regarding droughts, its general effects, and effect on personal life style.
- Subject to validation of drought triggers, develop specific sector-based and region-based response/mitigation measures for Drought Stages 1, 2, and 3.
- Study and evaluate tourism economic impacts resulting from drought conditions.

Long-Term Actions (18 – 24 months)

- Streamline the permitting process for selected actions during a drought.

- Have federal, state, or local mental health agencies provide assistance and education on drought related problems.
- Seek legislation to provide tax credits for farming losses due to drought.
- Increase program funding and activities of the NRCS PL-566, EQIP, and DLNR Forest Stewardship programs.
- Provide more crop suitability studies or have such details available to farmers in the field as this will give them the ability to make sound decisions on crops, planting cycles, alternative cropping, etc.
- Clarify or develop procedures for use of military surplus equipment for distribution of grain, water, or drought relief supplies/materials.
- Seek legislation to use “gray” water for agricultural/livestock purposes during a drought declaration emergency.
- Establish new crop insurance programs at both the federal and state levels or adapt existing programs to meet drought losses or damages.

ENVIRONMENTAL, PUBLIC HEALTH AND SAFETY TASK FORCE

Near-Term Actions (12 – 18 months)

- Develop a water supply inventory and map for use during drought-related emergencies such as wildland fire suppression. Inventory should include existing and alternate sources of water (i.e., dams, reservoirs, public and private water systems, etc.).
- Based on this inventory of available water supply, reach necessary agreements with landowners, operators, purveyors, etc. for access and use of such resources during emergency drought conditions (i.e., to provide water supply for fire suppression).
- Delineate areas on each island where non-potable water (e.g., salt water, treated effluent) can be used for fire suppression purposes. Develop corresponding maps clearly showing where non-potable water can (or cannot) be applied during fire suppression operations.
- Establish a State Drought Coordinator position to permanently carry on the functions temporarily provided by the Bureau of Reclamation.

Long-Term Actions (18 – 24 months)

- Develop a unified fire management plan and adequate funding to implement the plan, including development of a corresponding fire prevention education component (see “Drought and Wildland Fire Mitigation Plan”) and adequate funding.
- Develop a comprehensive Statewide Water Conservation Plan incorporating existing state and county water conservation measures.
- Establish a “hierarchy of water use” policy for future guidance and implementation during drought-related emergencies.

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APPENDIX A: FEDERAL AGENCY INDEX

Federal agencies provide several types of assistance to those adversely affected by drought. One type of assistance is to access hydrological and meteorological data that agencies collect as part of their mission or mandate and disseminate them to the states for timely drought assessment. Monetary and technical assistance are available for agricultural producers and business owners to mitigate losses related to drought. Technical assistance reduces the vulnerability of agricultural operations to drought.

There are 88 drought related federal programs, which were funded in last ten years. These programs are categorized into four broad areas (1) Preparedness, including planning and mitigation; (2) Information, including monitoring/prediction and research; (3) Risk management; and (4) Emergency response. Seven of these programs provide assistance for drought planning, 42 for drought mitigation, 22 for drought-related monitoring/prediction and research, and 47 for response. These numbers total more than 88 because some programs cover more than one aspects of drought.

Within federal government programs, water supply and droughts are considered together. A number of programs within the U.S. Department of Agriculture (USDA) provide assistance for actions that can lead to drought mitigation. The Small Watershed Act, for example, gives the Department authority to help rural communities address natural resource concerns in small watersheds. Eligible purposes include watershed management, emergency watershed restoration, water conservation, municipal and industrial water supply, recreation, and fish and wildlife protection.

In 1964, Congress passed the Resources Conservation and Development Act to assist local units of government address erosion problems, water management problems, and economic development needs. This program provides technical and financial assistance, but available funding has been limited to technical assistance for local Resource Conservation and Development Councils. The annual appropriation of about \$36 million provides each Council with a coordinator position and clerical support.

The 1985 Food Security Act directed the Secretary of Agriculture to enroll 45 million acres of highly erodible lands into the Conservation Reserve Program. This amount was reduced in subsequent farm bills to 36.4 million acres as a cost-savings measure. Farmers receive technical and financial assistance as well as an annual rental payment for installing and maintaining this area in permanent vegetative cover.

In 1996, Congress consolidated several of the Department's cost-share programs and created the Environmental Quality Incentive Program. The primary purpose of this program is to help farmers address their water quality problems, but it also provides technical and financial assistance for the installation of water conservation measures as well as livestock watering facilities. Cost-share is provided through long-term agreements that address an entire farm's resource needs. However, there is a controversy that this program sometimes limit public's

ability to obtain financial assistance to install drought mitigation measures such as cross fencing and livestock water development.

The following are the federal organizations and their specific activities that can assist the State of Hawaii during drought emergencies with loans, grants and programs for financial, material and personal support.

Federal Emergency Management Agency(FEMA) provides disaster assistance to states, local governments and nonprofit organizations when the President declares an emergency. FEMA also provides disaster assistance including unemployment insurance, temporary housing, and crisis counseling to individuals and families adversely affected by disasters or emergencies. They also provide grants to states for the suppression of forest and grassland fires.

National Weather Service(NWS) produces hydrologic forecasts, including water supply forecasts for the states and cooperates with the Natural Resources Conservation Service (NRCS) in the determination and production of water supply forecasts. The NWS also produces short-term weather forecasts for the state, collects and maintains meteorological records for weather stations around the state, including precipitation and temperature data and produces reports that summarize state meteorological data. NWS also conducts climate analyses and produces weekly Palmer Drought Severity Index values and Crop Moisture Index values for certain states.

U.S. Department of Agriculture, Farm Service Agency (FSA) provides emergency grant programs during periods of drought to eligible producers suffering losses from drought. FSA also provides guaranteed and insured loans to assist family farmers, ranchers, and aquaculture operators in recovering from losses resulting from droughts.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) is responsible for preparing monthly Surface Water Supply Index (SWSI) reports and monitoring of soil moisture conditions in the continental U.S. In Hawaii, NRCS does not currently prepare water supply forecasts. NRCS provides technical assistance to the agricultural community on matters such as farm conservation practices, water conservation, water quality improvement, and diversion of irrigation water, and assists ranchers with technical assistance for grazing land management. They also conduct soil surveys and soil suitability studies, together with conservation partners, to provide cost-shared financial assistance for implementation of conservation practices.

The U.S. Army Corps of Engineers (COE) addresses drought as a part of the hydrologic spectrum in its design of projects, including environmental restoration projects. However, the Corps has no authority or funding specialty for drought planning. Army Corps of Engineers operates federal reservoirs controlling releases of stored water for project purposes in periods of surplus runoff. They administer the “404 Permit” section of the Federal Clean Water Act, and the Federal Rivers and Harbors Act. Corps of Engineers also conducts regional meetings to gather public comment and respond to local concerns and problems related to Corps projects, such as flat water recreation during periods of droughts. They are responsible for construction of wells and transports water to farmers, ranchers, and political subdivisions within areas determined to be drought-distressed by the Chief of Engineers. Before Corps assistance is

considered, other applicable federal assistance authorities must be evaluated. The authority for these COE actions is authorized under Public law 84-99.

Small Business Administration (SBA) administers the economic injury loan program for small business, including agricultural cooperatives, adversely affected by community agricultural losses. Businesses that depend on the business of agricultural producers affected by drought are eligible if an SBA disaster declaration is in effect in the state.

Federal Crop Insurance Corporation provides insurance to farm owners and operators against unavoidable losses resulting from adverse conditions beyond the producer's control.

Department of the Interior, U.S. Geological Survey (USGS) is responsible for measuring and recording streamflow data for most of the major rivers and streams of the state. They also compare current streamflow data with historical data to evaluate current conditions. They are responsible for conducting surface water investigations, primarily as a cooperator with state and local agencies on water supply projects, and for determination of water supply/quality and evaluation of hazardous conditions. They maintain a database of streamflow data on a real-time basis at the local level and conducts research on hydrologic processes and the effects of climate change.

U.S. Department of Agriculture, U.S. Forest Service, assists states with wildland fire fighting and fire planning activities.

Department of the Interior, Bureau of Reclamation (BOR), manages, develops, and protects water and related resources in an environmentally and economically sound manner in the interest of the American public. Reclamation operates and maintains 13 major water storage reservoirs in the state. These projects provide water supplies for agricultural, municipal, industrial, and domestic uses. Fish and wildlife protection is also an additional benefit provided by the Reclamation projects. BOR in concert with states, tribes, water users, and others, develops staged drought management contingency plans and implements effective drought management measures and activities. Other drought related activities BOR is involved are:

- Works with other federal, state, and local agencies to enhance data collection and water supply forecasting capability to improve both water supply prediction and operational effectiveness.
- Reviews operating criteria, strategies, and plans for Reclamation projects to determine if changes would make projects more effective in mitigating drought impacts.
- Modifies project operations to minimize drought-related impacts. This includes operations that enhance water delivery to contractors but may also include actions to protect fish, wildlife, recreation, and other values.
- Offers programs that assist irrigation districts in securing adequate supplies of water and installing facilities for water delivery and distribution.

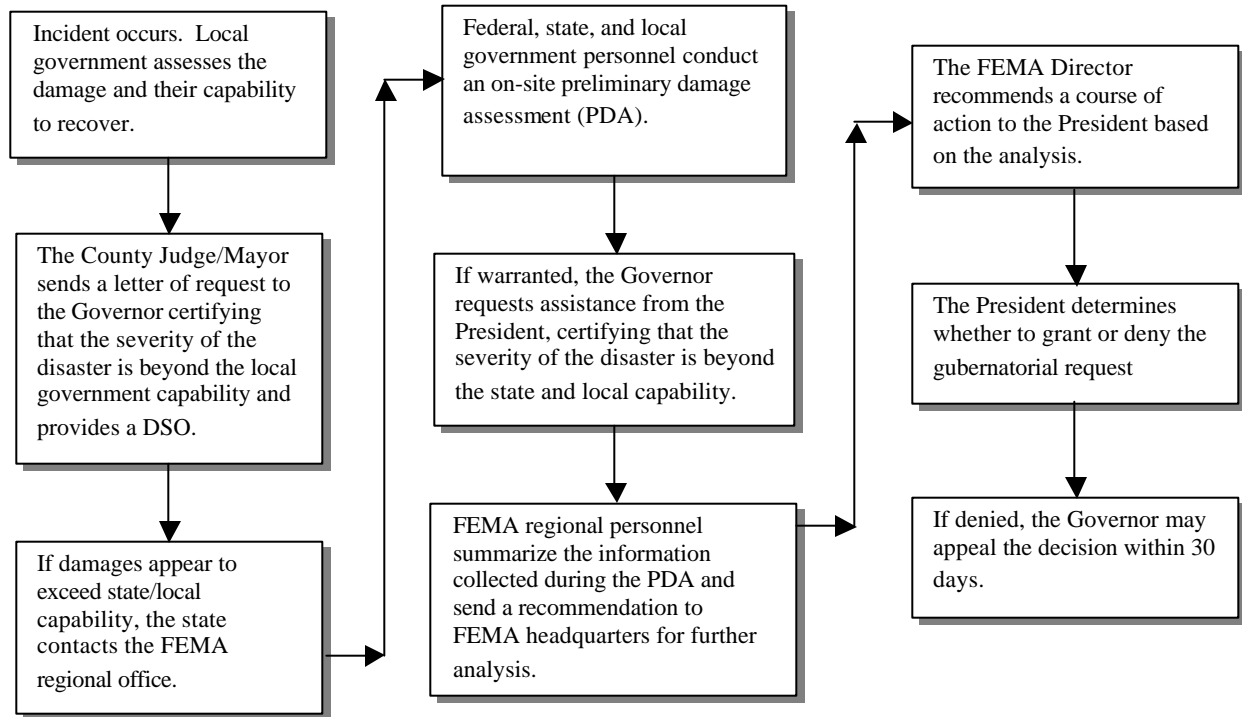
- Monitors and reports water supply conditions of Bureau of Reclamation projects, and projects future water supplies.
- Coordinates project operations with the Bureau of Indian Affairs (BIA) irrigation districts, and other operators of diversion facilities.
- Assess the need for changes in policy to better accommodate drought problems and solutions.
- Provides the public with informational and educational materials regarding water conservation. This includes water supply and forecast information for use by state and other federal agencies for drought assessment and management decision-making.
- Provides information and technical assistance on drought conditions and management programs and techniques to other federal and state agencies, tribes, water users organizations, and local entities.
- Implements programs authorized and funded by Congress through emergency legislation. These programs include grants and loans for water-related projects that reduce the impacts of drought. These projects are coordinated with state, federal, and local authorities, and with water user's organizations.
- Evaluates drought-related conditions on all Reclamation projects and identifies recommended relief measures. Any time water supplies fail to allow an adequate supply, Reclamation seeks to identify, with its contractors, methods to extend the available water supply to reduce adverse economic impacts.

DROUGHT-RELATED FEDERAL STATUTES

- PL 93-288, The Robert Stafford Disaster Relief and Emergency Assistance Act of 1988, as amended.
- PL 84-99, Emergency Authority, as amended.
- Safe Drinking Water Act of 1974 (PL-93-523)

PRESIDENTIAL DISASTER DECLARATION PROCESS

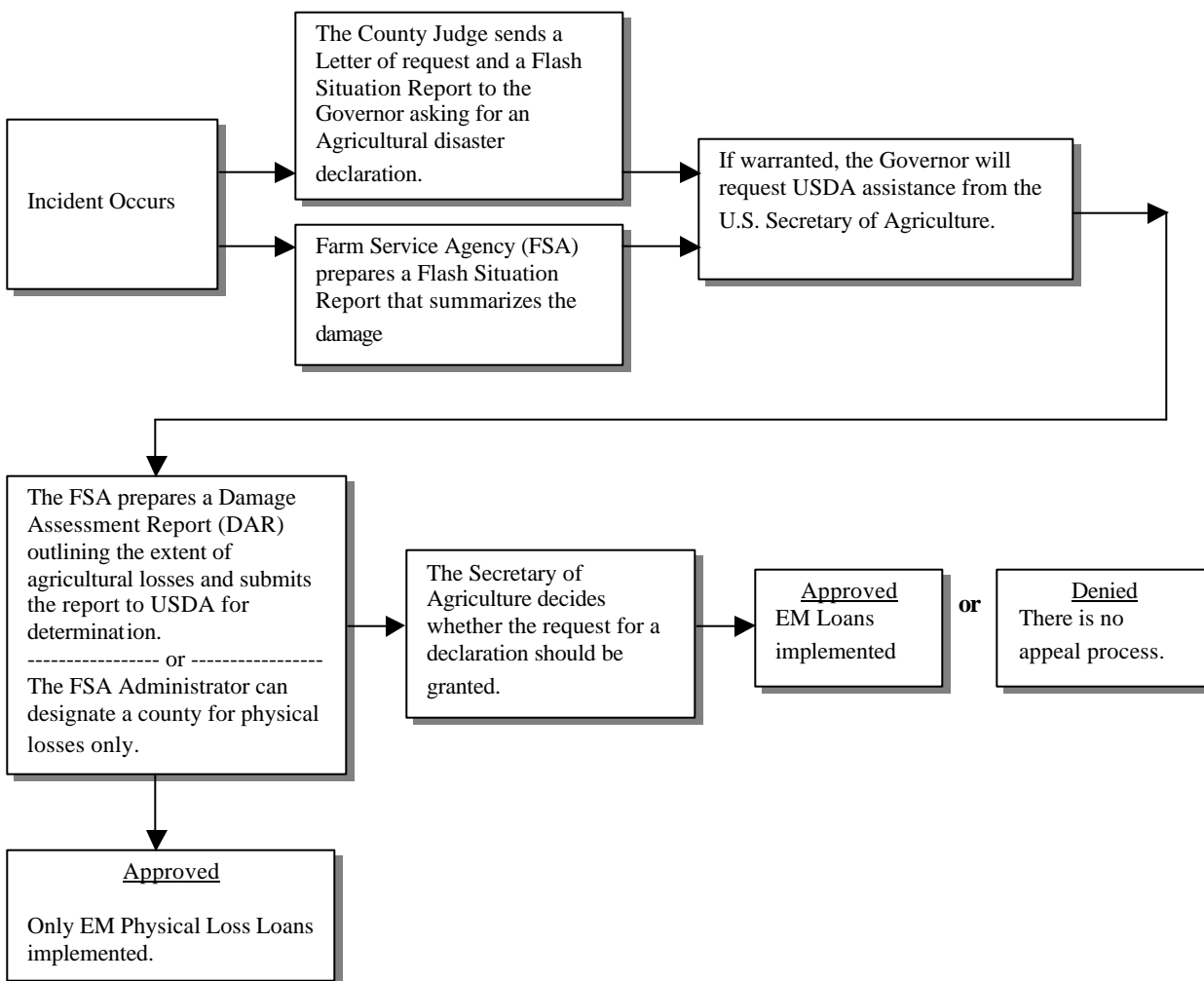
The Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 93-288 as amended authorizes the President to declare an emergency or major disaster in the state, if requested by the Governor, and to make federal assistance available to supplement state and local resources.



The Act does not prescribe specific criteria to guide FEMA’s recommendation or the President’s decision. As a prerequisite to federal disaster assistance under the Act, the Governor must take “appropriate response action” and provide information on the nature and amount of state and local resources committed to alleviating the results of the disaster. The preliminary damage assessment (PDA) is the mechanism used to determine the impact and magnitude of damage and the resulting unmet needs of individuals, businesses, the public sector, and the community as a whole. This information is used by DEM in preparing the Governor’s request and by FEMA in making a recommendation to the President as to whether assistance is warranted. The President then decides whether to approve the assistance requested and/or recommended. Generally, FEMA considers some or all of the following factors in making a recommendation to the President:

- The number of homes destroyed or sustaining major damage.
- The number of homes sustaining minor damage.
- The extent to which the damage is concentrated or dispersed.
- The estimated cost of repairing the damage.
- The demographics of the affected areas (e.g. income levels, unemployment, and concentrations of the elderly).
- The extent to which the damage is covered by insurance.
- The extent to which the disaster area is traumatized.
- The extent of disaster-related unemployment.
- The level of assistance available from other federal agencies (e.g. SBA’s home and business loans).
- The state and local government’s capabilities for dealing with the disaster.
- The level of assistance available from voluntary organizations (e.g. the American Red Cross).
- The availability of rental housing.
- The extent of health and safety problems.
- The extent of damage to facilities providing essential services (e.g. medical, utilities, police, etc.)

USDA DISASTER DECLARATION PROCESS



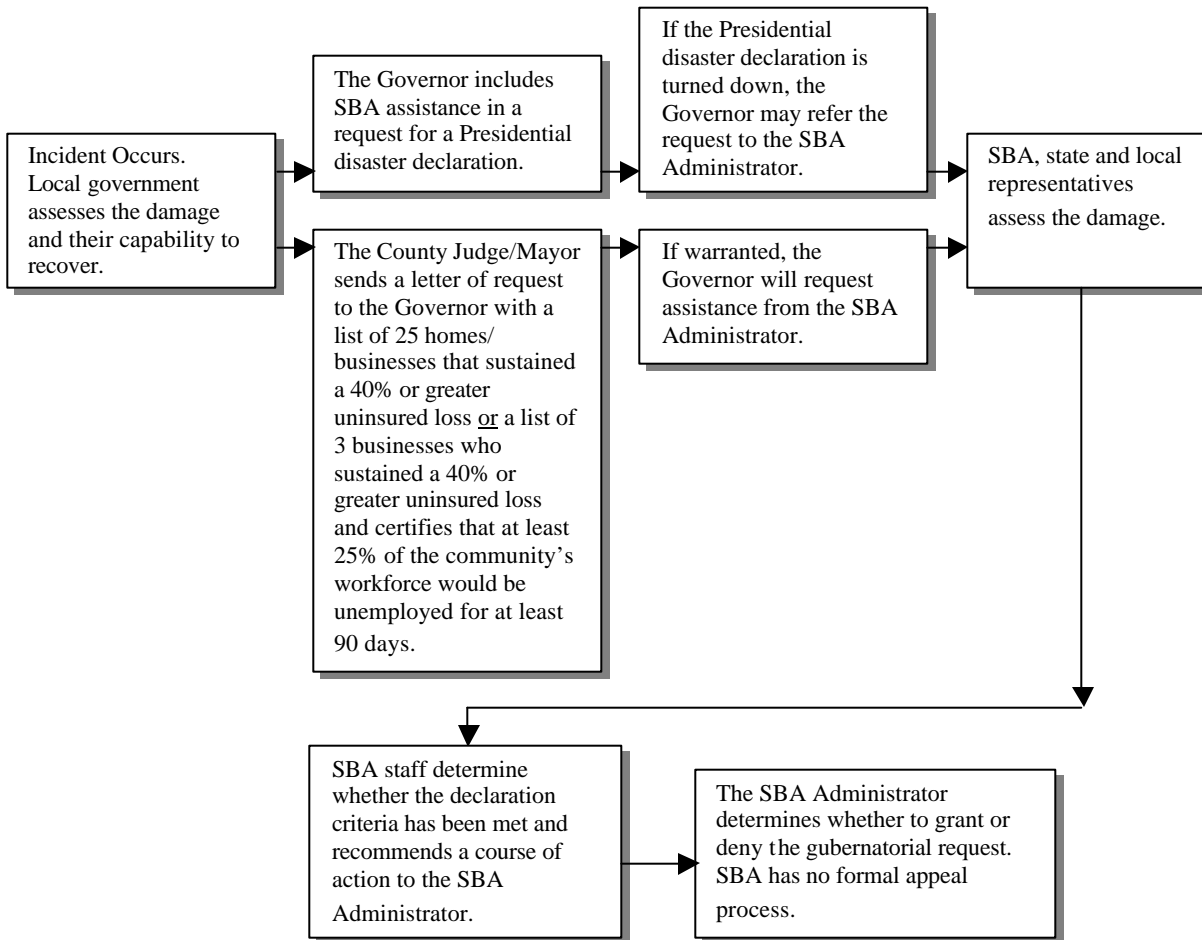
A U.S. Department of Agriculture (USDA) declaration may be approved if, as a result of a natural disaster within a county,

- a request is made within 90 days of the incident,
- the incident is “weather related”, and:
- there is at least 30% county-wide production loss of crops

A USDA declaration will result in the implementation of the Emergency Loan (EM) Program through the FSA. This program enables eligible farmers and ranchers in the affected county as well as contiguous counties to apply for low interest loans. A USDA declaration will automatically follow a Presidential declaration for counties designated major disaster areas and those counties that are contiguous to a declared county - including counties that are across state lines. As part of an agreement with the USDA, the Small Business Administration (SBA) offers low interest loans for eligible businesses that suffered economic losses in declared and contiguous counties that have been declared by the Secretary of Agriculture. These loans are referred to as Economic Injury Disaster Loans (EIDL).

In situations involving serious physical losses, the FSA Administrator may also designate a county a disaster area, but only for physical loss loans.

SBA DISASTER DECLARATION PROCESS



An SBA declaration may be approved if, as a result of disaster-related damage within a county,

- at least 25 homes or businesses have sustained uninsured losses of at least 40 percent of their replacement value or
- at least 3 businesses have sustained uninsured losses of at least 40 percent of their replacement value and, as a direct result of the disaster, at least 25 percent of the workforce in the community would be unemployed for at least 90 days

To determine the extent of damage, SBA, state and local officials jointly conduct assessments in the affected counties following the Governor's request. If the Governor has requested a Presidential disaster declaration for Individual Assistance, SBA's policy is to suspend action on a request it receives until the President has made a decision on the Governor's request. The following is a list of other situations when SBA assistance may be available:

In the event of a Presidential disaster declaration, the declared county is eligible to apply for Physical Disaster Loans and Economic Injury Disaster Loans (EIDL) through the SBA. Contiguous counties, may apply for Economic Injury Disaster Loans only.

In the event of an SBA only declaration, the declared county as well as the contiguous counties are eligible for both Physical Loss and Economic Injury Disaster Loans.

In the event of a U.S. Department of Agriculture Secretarial Declaration, the declared county as well as any contiguous counties are eligible to apply for Economic Injury Disaster Loans only.

APPENDIX B: STATE AGENCY INDEX

The following agencies/organizations of the State of Hawaii are responsible for specific response actions and for implementing certain recommended drought plan provisions during drought and non-drought periods.

OFFICE OF THE GOVERNOR

****To be developed in Phase 2****

DEPARTMENT OF AGRICULTURE

- **Chapter 141, HRS:** Department of Agriculture (DOA) powers: act to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency, and ensure availability of agriculturally suitable lands.
- **Chapter 152, HRS:** DOA duties: maintain constant vigilance for incipient infestation of specific noxious weeds...and shall use those procedures and methods to control or eradicate the infestations of noxious weeds.
- **Chapter 155, HRS:** DOA powers and duties provide relief to farmers in times of emergencies.

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT AND TOURISM

****To be developed in Phase 2****

DEPARTMENT OF DEFENSE

State Civil Defense Division

Hawaii Revised Statutes (HRS), Chapter 26-21, establishes the Department of Defense who “shall be responsible for the defense of the State and its people from mass violence, originating from either human or natural causes.” Further, HRS, Chapter 128, delineates the functions and responsibilities of civil defense to include disasters and emergencies.

The Governor’s Memo 90-13, State of Hawaii Plan for Emergency Preparedness, Volume III, Disaster Response and Assistance, September 21, 1990, provides State and county governments a basis for disaster planning, preparedness, and training. Also, the plan establishes relationships among agencies, fixes responsibility and accountability, and sets forth the actions to be taken by departments and agencies of the State and each county government. Disaster is defined as “any

destructive event resulting in significant physical loss or destruction and social disruption caused by natural or man-caused hazards or disaster agents. Natural disasters include storms, high winds, flash floods, high surf, hurricanes, tornadoes, droughts, earthquakes, tsunamis, volcanic eruptions, landslides, mudslides, and fires.” The mission of the State and counties are defined as follows:

- Prevent or minimize loss of life
- Alleviate suffering
- Reduce damage or destruction to property
- Provide for public safety, health and welfare
- Restore disrupted public systems and services
- Expedite recovery and rehabilitation

Specific responsibilities of the State Civil Defense Division include the following:

- Coordinate warning procedures and warning dissemination
- Collect, collate, evaluate, and disseminate damage assessment information and organize State Disaster Field Teams to assist with damage assessment
- Administer the State’s Major Disaster Fund
- Coordinate requests for support of disaster operations
- Coordinate disaster assistance programs administered by the State, Federal, and private agencies

DEPARTMENT OF HAWAIIAN HOME LANDS

To be developed in Phase 2

DEPARTMENT OF HEALTH

To be developed in Phase 2

- **Chapter 11-19, HAR, Emergency Plan for Safe Drinking Water:** Identifies drought as a "Type B" emergency; authorizes the Dept. of Health to coordinate with other governmental agencies and the private section to provide water to affected areas; prescribe appropriate procedures to be undertaken by water suppliers and consumers to minimize health risks resulting from contamination of drinking water; notify customers regarding the seriousness of the emergency and measures to undertake to minimize health risks; determine whether alternative water supplies are safe and whether the means to transport or deliver the water may have adverse impact on the water quality
- **Chapter 11-20, HAR, Potable Water System:** Regulate all public water systems which provide water for human consumption through pipes or other constructed conveyances if the system has 15 or more service connections, or regularly serves an average of at least 25 persons daily at least 60 days out of the year.

DEPARTMENT OF LAND AND NATURAL RESOURCES

Commission on Water Resource Management

The Commission on Water Resource Management is the state agency charged with the management of all water resources. The Commission's mandate is set forth in Chapter 174C, Hawaii Revised Statutes ("State Water Code"). The declaration of policy set forth in the State Water Code recognizes the "need for a program of comprehensive water resources planning to address the problems of supply and conservation of water." The policy further states that "the state water code shall be liberally interpreted to obtain the maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses."

Efforts to implement this policy have included preparation of a multi-component Hawaii Water Plan (HWP). The HWP consists of the following elements: 1) Water Resources Protection Plan; 2) Water Quality Plan; 3) State Water Projects Plan; 4) Agricultural Water Use and Development Plan; and 5) County Water Use and Development Plans prepared by each of the four counties. These plans which collectively form the basis of the HWP serve to protect against potential threats to water resources and are intended to formulate an integrated program for the protection, conservation, and management of the waters in each County. Accordingly, certain elements from each of these plans should be considered and, where appropriate, integrated during the development of any statewide drought mitigation plan.

The State Water Code (Section 174C-62, HRS) also requires that CWRM formulate a plan for implementation during periods of water shortage. As part of this plan, the CWRM shall adopt a reasonable system of permit classification according to source of water supply, method of extraction or diversion, use of water, or a combination thereof. The CWRM, by rule, may declare a water shortage when insufficient water is available to meet the requirements of the permit system or when conditions are such to require a temporary reduction in total water use to protect water resources from serious harm. However, such declaration of water shortages may only occur within designated water management areas.

If the CWRM finds that the restrictions imposed are not sufficient to protect public health, safety or welfare, or the health of animals, fish, or aquatic life, or a public water supply, or recreational, municipal, agricultural, or other reasonable uses, the CWRM may declare the existence of a water emergency. Declaration of a water emergency shall be through the issuance of a CWRM order and may be instituted for any area, whether within or outside of a water management area. During such a water emergency, the CWRM may impose requirements including, but not limited to, apportioning, rotating, limiting, or prohibiting the use of water resources within a given area. Notwithstanding such provisions, appurtenant rights are preserved even during water shortages or designation of a water emergency.

It is further envisioned that elements (if not all) of the State Drought Plan should be incorporated within the Water Resources Protection Plan component of the HWP. Accordingly, the Statewide Framework for Updating the Hawaii Water Plan adopted by the CWRM includes provisions requiring the integration of the State Drought Plan upon its eventual completion. The purpose of

this Drought Plan is to help identify and provide direction when drought-related water shortages and/or water emergencies arise so that the CWRM may base its orders on such criteria.

Division of Forestry and Wildlife

The DLNR Division of Forestry and Wildlife (DOFAW) is responsible for all wildfires on forest reserves, natural area reserves, wildlife and plant sanctuaries and public hunting areas. It also cooperates with established fire control agencies for the protection of other wildlands not within the department's protection areas to the extent needed to provide for public safety.

DOFAW cooperates with county fire control agencies and the federal government in developing plans and programs and mutual aid agreements for assistance in the prevention, control, and extinguishment of forest, grass, brush, and watershed fires not within the department's fire protection responsibilities described above.

During periods of high fire danger or drought, DOFAW has the statutory authority to restrict access to, or close any lands within its jurisdiction. It can also restrict outdoor burning. DOFAW has adopted a Fire Management Handbook which specifies its standards for prevention, suppression and suppression. The Document provides a structured approach in providing for public/firefighter safety and minimizing damage to Hawaii's environment. Funding for the fire management program is provided by the State's general fund and federal cost share programs through the USDA Forest Service. These include the State Fire Assistance (SFA) and Volunteer Fire Assistance (VFA) programs. Additionally, DOFAW is a key agency within the State who can trigger provisions of the Stafford Act (Fire Suppression Assistance) which provides for Federal Emergency Management Agency (FEMA) funding assistance in situations where forest and grass fires on public or private lands threaten a major disaster to communities and economies.

DOFAW has existing mutual aid agreements with all county fire departments statewide. These mutual aid agreements identify the responsibilities of each party as well as other fire management activities such as joint participation in prevention, training and equipment acquisition.

- **Chapter 185, Sec. 185-3(c3 & c4), HRS, Land Fire Protection Law:** Authorizes the administrator of the Division of Forestry and Wildlife to issue fire warning notices during dry periods; gives authority to the administrator to close forest reserves, public hunting areas, wildlife and plant sanctuaries, and natural area reserves to public access or restrict their use during dry periods when necessary, to reduce fire risk.

Soil and Water Conservation Districts

****To be developed in Phase 2****

- **Chapter 180, HRS:** Soil and Water Conservation Districts ("SWCD") powers provide for and encourage demonstrations relative to control and prevention of erosions and conservation

of soil and water resources; and develop plans for conservation of soil and water resources and control and prevention of erosion.

- **Chapter 180C, HRS:** County governments, in cooperation with SWCD, enact count ordinances for the purpose of controlling soil erosion and sediment.

UNIVERSITY OF HAWAII

County Extension Services

****To be developed in Phase 2****

State Climatology Office

The Hawaii State Climatology Office (HSCO) at the University of Hawaii at Manoa provides climate data and information to the general public. The HSCO collects and archives historical climate (rainfall, temperature, wind, etc.) data for Hawaii and provides scientific advice regarding physical mechanisms leading to drought. Given available funding in the near future, the HSCO is working towards developing drought prediction models, taking into account both windward and leeward locations and the Pacific Decadal Oscillation. An evaluation of the models' performance would be completed to assess the reliability of resulting long-lead drought forecasts expressed in a probabilistic manner.

STATE FIRE COUNCIL

The State Fire Council is comprised of the four county fire chiefs, and has been established within the State Department of Labor and Industrial Relations. The State Fire Council may advise and assist the county fire departments where appropriate. They may prescribe standard procedures and forms relating to inspections, investigations and reporting of fires. The Council may also approve plans for cooperation among the county fire departments and may advise the Governor and the Legislature with respect to fire prevention and protection, life safety, and other functions or activities for which the various county fire departments are generally responsible.

The State Fire Council also serves as a focal point through which all applications to the federal government for federal grant assistance for fire-related projects shall be made.

- **Chapter 132-16 State Fire Council; composition; functions.** (a) There is a established a state fire council which shall be placed within the department of labor and industrial relations for administrative purposes. The state fire council shall consist of the fire chiefs of the counties. The state fire council may appoint an advisory committee to assist it in carrying out its functions under this chapter.

APPENDIX C: COUNTY OF KAUAI INDEX

OFFICE OF THE MAYOR

To be developed in Phase 2

DEPARTMENT OF WATER

To be developed in Phase 2

COUNTY CIVIL DEFENSE

To be developed in Phase 2

REGION SPECIFIC DROUGHT ASSESSMENT

Table C1: Water Supply Sector Assessment for the State Kokee Water System, Kauai

Sector: Water Supply		
Category: Drinking Water		
Location: State Kokee Water System		
Source: Ground water well (12 gpm)		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Decreased shallow well capacity due to reduced recharge of perched ground water	<ul style="list-style-type: none">• Complete construction of new well (31 gpm) and place in service immediately.• Develop additional ground-water wells.	DOW CWRM
Increased system water demand	<ul style="list-style-type: none">• Develop additional water tank storage capacity to meet increased demand.• Analyze the feasibility of developing surface water sources and storage reservoirs to meet increased demand.• Reduce water system leakage. Replace old pipelines, oversizing if necessary.• Explore partnerships with the Navy and Air National Guard to improve this water system• Implement water conservation programs among customers, and mandatory restrictions if necessary.• Encourage re-use of gray-water for irrigation (must obtain approval of DOH).• Supplement wastewater treatment systems with non-potable water during periods of low flow to keep these systems functioning.	DOW DLNR CWRM DOH Navy Air National Guard
Increase exposure to wildfires or structure fires	<ul style="list-style-type: none">• Develop additional water tank storage capacity to meet increased demand for fire fighting purposes.• Analyze the feasibility of developing surface water sources and storage reservoirs for fire fighting purposes.	

Table C2: Water Supply Sector Assessment for the Waimea Water System, Kauai

Sector: Water Supply		
Category: Drinking Water		
Location: Waimea Water System		
Source: Waimea Well No. 2		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Increased salinity (i.e., chlorides) due to heavier pumping and reduced ground water recharge	<ul style="list-style-type: none"> • Restore Waimea Shaft to service by installing a water treatment system to treat the ground water under the influence of surface water. • Develop additional water sources. • Improve interconnection between the Kekaha and Waimea water systems (e.g., pipelines and/or booster pump station) • Implement water conservation measures among DOW customers. 	DOW DOH CWRM

Table C3: Water Supply Sector Assessment for the County Department of Water and Private Water Systems, Kauai

Sector: Water Supply		
Category: Drinking Water		
Location: County Department of Water and Private Water Systems		
Source: Various sources		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Declining source capacity due to reduced ground water recharge and increased pump age to meet increased demand	<ul style="list-style-type: none"> • Implement water conservation measures to reduce customer demand, and if necessary, mandatory restriction on water use. • Develop additional ground-water sources. (e.g., Develop new wells in the Waimea-Kekaha Water System, the Kilauea Water System, the Hanalei Water System, and Makaweli Valley) • Improve interconnection between water systems to make additional source capacity available (regionalization). (e.g., Install pipeline and booster pumping station between the Kalaheo and Lawai-Omao Water Systems, Install a pipeline between the Koloa and Lihuw Water Systems) • Develop additional storage tank capacity. • Reduce system leakage (i.e., unaccounted-for-water) 	DOW DOH CWRM DLNR Private Water Purveyors

DROUGHT-RELATED COUNTY ORDINANCES

Article XII, Sec. 12.03 of the Kauai County Ordinance - gives the power of authority to the Kauai Fire Department to provide and effective program and leadership for countywide fire prevention, fire control and rescue operations.

Department of Water Rules and Regulations. (Specific section citations to be added.)

APPENDIX D: CITY AND COUNTY OF HONOLULU INDEX

OFFICE OF THE MAYOR

To be developed in Phase 2

BOARD OF WATER SUPPLY

To be developed in Phase 2

COUNTY CIVIL DEFENSE

To be developed in Phase 2

REGION SPECIFIC DROUGHT ASSESSMENT

Table D1: Water Supply Sector Assessment for the Various Water Systems, Oahu

Sector: Water Supply		
Category: Drinking Water		
Location: Various Water Systems		
Source: Various ground water sources		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Reduced or no pumpage from existing water sources that show a high level of chlorides or have a short recharge time with limited storage	<ul style="list-style-type: none">• Shut down impacted wells and use other wells to supply water to affected areas.• If pumpage from other sources is limited because of extended drought conditions and/or aquifer levels are at a dangerously low level, implement mandatory restrictions on water use.• If pumpage from other sources is not available, institute mandatory water use restrictions and provide water wagons with the instruction that water is only for health and safety purposes; also fill existing reservoirs and restrict for emergency purposes (fires).• Prior to drought conditions, identify existing sources that would be impacted by high chlorides and identify and install improvements to blend water with more potable sources or to supplement distribution systems.	BWS
Reduced or no pumpage due to drought AND system failure due to main breaks or power loss	<ul style="list-style-type: none">• Identify those systems that are isolated and would be hardest impacted due to both drought and infrastructure failure and give priority to insuring that infrastructure is up-to-date and within standards in department's Research and Facilities Improvement Program (RFIP).• If power loss occurs, deploy emergency portable generators to impacted pump stations to insure availability of water.	BWS

Reduced capacity of system due to shortage in available storage capacity	<ul style="list-style-type: none"> • Utilize sources outside of areas with storage capacity deficits to supplement the internal sources to insure that there is an adequate water supply. • If drought conditions persist beyond external sources ability to supplement internal sources, implement mandatory water use restrictions. 	BWS
Reduced or no production from other utilities in the event water supply is reduced	<ul style="list-style-type: none"> • Form working partnerships with other utilities to address supply problems/concerns in times of drought and develop emergency alternatives for insuring continued supply of water for operations that would impact public. 	BWS

DROUGHT-RELATED COUNTY ORDINANCES

Sec 6-504 of the Revised Charter of the City and County of Honolulu - identifies the powers, duties, and functions of the fire chief of the Honolulu Fire Dept. This includes performing firefighting and rescue work in order to save lives and property from fires and from emergencies arising on the sea and hazardous terrain.

Board of Water Supply Rules and Regulations. (Specific section citations to be added.)

APPENDIX E: COUNTY OF MAUI INDEX

OFFICE OF THE MAYOR

****To be developed in Phase 2****

DEPARTMENT OF WATER SUPPLY

****To be developed in Phase 2****

COUNTY CIVIL DEFENSE

****To be developed in Phase 2****

REGION SPECIFIC DROUGHT ASSESSMENT

****To be developed in Phase 2****

DROUGHT-RELATED COUNTY ORDINANCES

Chapter 7, Sec. 8-7.3 of the Maui County Ordinance, - authorizes the fire chief to provide fire protection to the people and property of the county of Maui.

Department of Water Supply Rules and Regulations. (Specific section citations to be added.)

APPENDIX F: COUNTY OF HAWAII INDEX

OFFICE OF THE MAYOR

To be developed in Phase 2

DEPARTMENT OF WATER SUPPLY

To be developed in Phase 2

COUNTY CIVIL DEFENSE

To be developed in Phase 2

REGION SPECIFIC DROUGHT ASSESSMENT

Table F1: Water Supply Sector Assessment for the South Kohala Water System, Hawaii

Sector: Water Supply		
Location: South Kohala Water System		
Source: Kohakohau and Waikoloa Stream		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Drinking Water	<ul style="list-style-type: none">• Implement conservation program keyed to Waikoloa Reservoirs in accordance with the following indicators:<ul style="list-style-type: none">• 150 mg – max storage• 130 mg – Water Conservation<ul style="list-style-type: none">• 10% reduction• 115-120 mg – Water Restriction• 25% reduction• Activate Parker Well<ul style="list-style-type: none">• 110 mg – Activate Waimea Country Club Well• 100 mg – Activate other sources• 80-90 mg – Mandatory Restriction• Pursue development of additional wells.• Develop conservation agreements with large users.• Promote an island-wide water conservation program.	DOH Parker Ranch DOA Waimea Country Club DLNR
Irrigation	<ul style="list-style-type: none">• Encourage improvement to DOA agricultural water system.• Explore partnership with NRCS to implement and exchange of water system components.• Encourage the implementation of best management practices for water conservation.	DOA Farm Bureau UH Ext. FSA SWCD NRCS DLNR
Livestock	<ul style="list-style-type: none">• Initiate emergency forage program.• Promote rangeland management and planning program.	Cattlemen's Assoc. DOA Parker Ranch DLNR

Table F2: Water Supply Sector Assessment for the Makapala/Niulii Water System, Hawaii

Sector: Water Supply		
Location: Makapala/Niulii Water System		
Source: Murphy Tunnel		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Drinking Water	<ul style="list-style-type: none"> Implement conservation program as warranted by reservoir, rainfall, and consumption monitoring. Utilize nearby existing USGS monitoring well for emergency use only. Pursue development of new well sources. Promote an island-wide water conservation program. 	DOH DOA DLNR NOAA County CD USGS

Table F3: Water Supply Sector Assessment for the Kukuiahae Water System, Hawaii

Sector: Water Supply		
Location: Kukuiahae Water System		
Source: Spring (1)		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Drinking Water	<ul style="list-style-type: none"> Implement conservation program as warranted by reservoir, rainfall, and consumption monitoring. Utilize nearby existing USGS monitoring well for emergency use only. Pursue development of new well sources. Promote an island-wide water conservation program. Continue to support USGS well drilling program. 	DOH DOA DLNR NOAA County CD USGS

Table F4: Water Supply Sector Assessment for the Haina Water System, Hawaii

Sector: Water Supply		
Location: Haina Water System		
Source: Deep well		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Drinking Water	<ul style="list-style-type: none"> Implement conservation program as warranted by reservoir, rainfall, and consumption monitoring. Utilize nearby existing Lower Hamakua Ditch with micro-filtration. Initiate a public awareness program for consumption of treated non-potable water. Pursue development of new well sources. Promote an island-wide water conservation program. Continue to support USGS well drilling program. 	DOH DOA DLNR NOAA County CD USGS Bishop Estate

Table F5: Water Supply Sector Assessment for the Papaikkou/Paukaa Water System (Kaieie Mauka), Hawaii

Sector: Water Supply		
Location: Papaikou/Paukaa Water System (Kaieie Mauka)		
Source: Papaikou Spring		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Drinking Water	<ul style="list-style-type: none"> Implement conservation program as warranted by reservoir, rainfall, and consumption monitoring. Haul water by tankers as required. Pursue development of new well sources and reservoir. Promote an island-wide water conservation program. Continue to support USGS well drilling program. 	DOH DOA DLNR NOAA County CD USGS C. Brewer

Table F6: Water Supply Sector Assessment for the Waiohinu/Naaalehu Water System, Hawaii

Sector: Water Supply		
Location: Waiohinu/Naaalehu Water System		
Source: Haa Springs/Mt. House Tunnel and Naaalehu Well		
<u>Impacts</u>	<u>Response and Mitigation Actions</u>	<u>Response Agency</u>
Drinking Water	<ul style="list-style-type: none"> Implement conservation program as warranted by monitoring pumping hours of deep well and booster pumps. Pursue development of additional wells and reservoir. Develop conservation agreements with large users. Promote an island-wide water conservation program. Continue to support USGS well drilling program. 	DOH DLNR USGS SWCD
Irrigation	<ul style="list-style-type: none"> Encourage the implementation of best management practices for water conservation. Develop conservation agreements with large users. Promote the repair of existing plantation agricultural water system in coordination with NRCS. Refer farmers that have suffered crop loss to FSA for any emergency assistance. 	DOA Farm Bureau UH Ext. FSA SWCD NRCS DLNR
Livestock	<ul style="list-style-type: none"> Initiate emergency forage program. Promote rangeland management and planning program. Promote the repair of abandoned plantation agricultural water system in coordination with NRCS. 	Cattlemen's Assoc. DOA DLNR NRCS

DROUGHT-RELATED COUNTY ORDINANCES

Chapter 4., Sec. 6-4.2, County Charter of the County of Hawaii, 1991 - gives authorization to the fire department to exercise and perform its duties prescribed by ordinance.

Department of Water Supply Rules and Regulations. (Specific section citations to be added.)

APPENDIX G: MEMBERSHIP

HAWAII DROUGHT COUNCIL

Agency

Office of the Governor

Department of Agriculture

Department of Land and Natural Resources

City and County of Honolulu Representative

County of Kauai Representative

Department of Defense

East Maui Irrigation Co., Ltd.

Hawaii Association of Conservation Districts

Hawaii Cattlemen's Council

Hawaii County Representative

Hawaii Farm Bureau

Maui County Representative

Member

Sam Callejo

James J. Nakatani (co-chair)

Timothy E. Johns (co-chair)

Clifford Jamile

Ernest Lau/Mark Marshall

Major General Edward L. Correa, Jr.

Garret Hew

David Nobriga

Dr. Calvin Lum

Milton Pavao (Interim)

Warren Watanabe

Myles Inokuma

WATER RESOURCES COMMITTEE

Agency

**Commission on Water Resource
Management (DLNR)**

Honolulu Board of Water Supply

Agricultural Development Division (DOA)

Commission on Water Resource Management

Hawaii County Department of Water Supply

Kauai County Department of Water

Maui Department of Water Supply

National Weather Service

State Civil Defense Division (DOD)

U.S. Geological Survey

University of Hawaii

Member

Linnel T. Nishioka (co-chair)

Bert Kuioka (co-chair)

Donald Martin

Neal Fujii

Glenn Ahuna

Ernest Lau

George Tengan

Kevin Kodama

Larry Kanda

Richard Fontaine

Dr. Pao-Shin Chu

WATER SUPPLY TASK FORCE

Agency

East Maui Irrigation Co., Ltd.

Kauai Department of Water

Agricultural Resource Management Division
(DOA)

Amfac Properties, Inc.

Commission on Water Resource Management
(DLNR)

Department of Hawaiian Home Lands

Estate of James Campbell

Gay and Robinson, Inc.

Gay and Robinson, Inc.

Grove Farm Properties, Inc.

Hawaii Department of Water Supply

Hawaiian Commercial & Sugar Co.

Honolulu Board of Water Supply

Kamehameha Schools

Maui Department of Water Supply

Maui Pineapple Co., Ltd.

Princeville Utilities

Safe Drinking Water Branch (DOH)

State Civil Defense Division (DOD)

Ulupalakua Ranch, Inc.

Wailuku Agribusiness Co., Inc.

Member

Garret Hew (co-chair)

Ernest Lau (co-chair)

Paul Matsuo

Dottie Bekeart

Dean Nakano

Rebecca Alakai

George Hiu

Alan Kennett

Charles Okamoto

Mike Furukawa

Glenn Ahuna

John Hoxie, Jr.

Bert Kuioka

Manabu Tagomori

George Tengan

Wes Nohara

Larry Dill

Bill Wong

Al Kang

Anthony Durso

Clayton Suzuki

AGRICULTURE AND COMMERCE TASK FORCE

Agency

**Agricultural Resource Management
Division (DOA)**

**Hawaii Association of Conservation
Districts**

Agribusiness Development Corp.

Castle and Cooke Hawaii, Inc.

Commission on Water Resource Management
(DLNR)

Del Monte Fresh Produce

Department of Business, Economic
Development and Tourism

Member

Paul Matsuo (co-chair)

Mike Tulang (co-chair)

Alfred Lee

Beverly Kaku

Dean Nakano

Bob Pang

Dole Food Co., Hawaii
Estate of James Campbell
Estate of James Campbell
Hawaii Farm Bureau (Big Island)
Farm Services Agency
Hawaii Cattlemen's Council
Hawaii Farm Bureau (Maui)
Kahua Ranch, Ltd.
Kamehameha Schools
Land Division (DLNR)
MacFarms of Hawaii, Inc.
Natural Resources Conservation Service
(USDA)
Robinson Trusts

John Hirota
Bert Hatton
George Hiu
Diane Ley
Joann Nakata
Dr. Calvin Lum
Warren Watanabe
Monty Richard, Jr.
Manabu Tagomori
Cecil Santos
Hillary Brown
Kenneth Kaneshiro

William Paty

ENVIRONMENT, PUBLIC HEALTH AND SAFETY TASK FORCE

Agency

Division of Forestry and Wildlife (DLNR)
Safe Drinking Water Branch (DOH)
Commission on Water Resource Management
(DLNR)
Division of Forestry and Wildlife (DLNR)
Honolulu Fire Department
Oahu Civil Defense Agency
State Civil Defense Division (DOD)

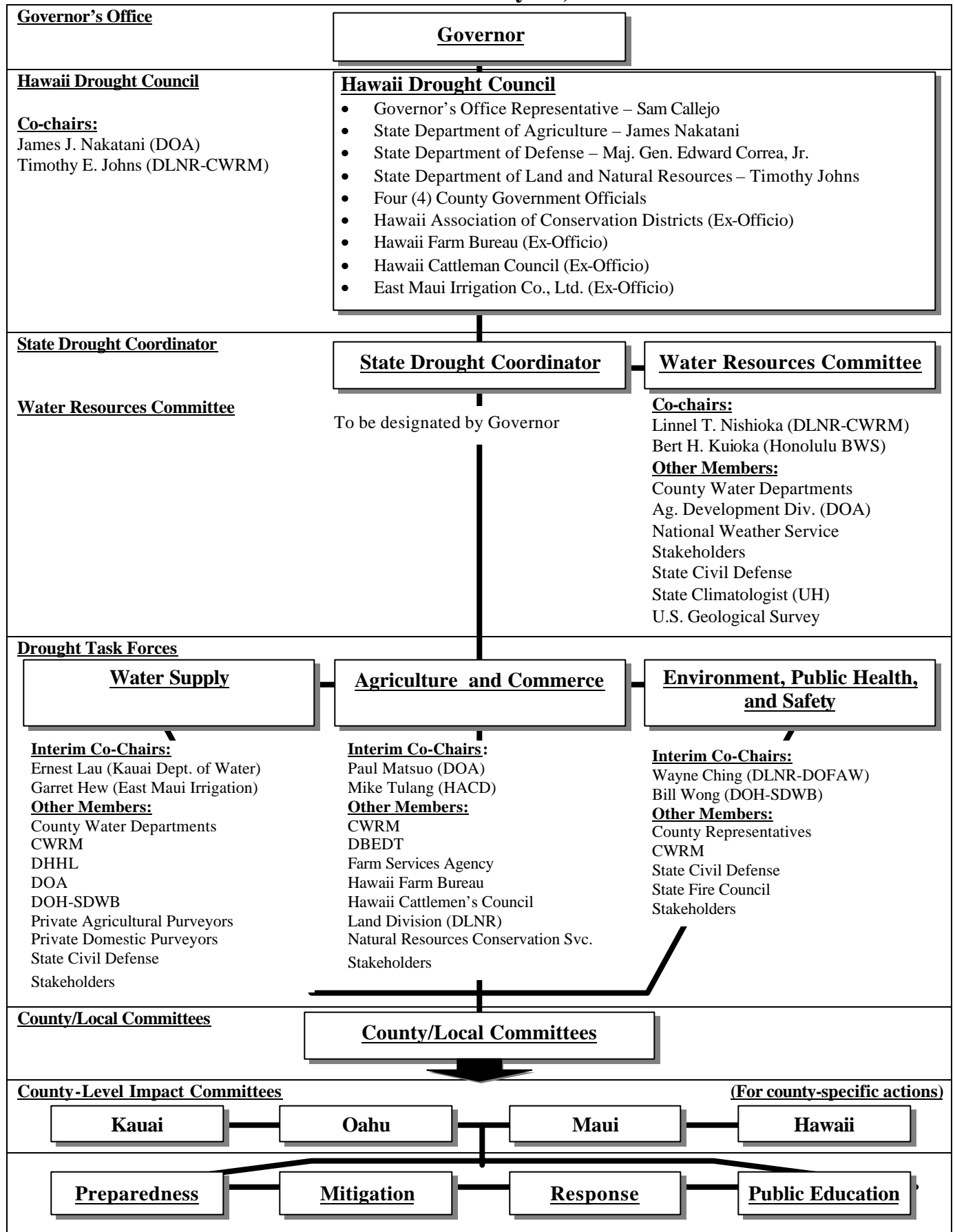
Member

Wayne Ching (co-chair)
Bill Wong (co-chair)
Dean Nakano

Pat Costales
Capt. Paul Gerard
Gary Susag
Larry Kanda

DROUGHT LEADERSHIP STRUCTURE

July 15, 2000



APPENDIX H: INTERNET RESOURCES

This appendix provides a comprehensive list of available Federal Assistance Programs and sources that may be utilized to prevent or mitigate the impacts of a drought event.

This list is available from the Website of the Western Drought Coordination Council at **<http://enso.unl.edu/wdcc/products/programs.pdf>**.

A specific listing of Disaster Assistance Available from the United States Department of Agriculture is available from the USDA Website at **<http://www.usda.gov/da/disaster.html>**.

Drought Monitoring

National Drought Mitigation Center's Drought Watch
<http://enso.unl.edu/ndmc/watch/watch.htm>

Western Drought Coordination Council
<http://enso.unl.edu/wdcc>

Western Regional Climate Center's SPI Matrix
<http://www.wrcc.sage.dri.edu/spi/spi.html>

Western Regional Climate Center Climate Monitoring
<http://wrcc.sage.dri.edu/monitor/wdccmon.html>

Climate Resources Monitoring

Climate Prediction Center (CPC)
http://nic.fb4.noaa.gov/products/predictions/analysis_monitoring

Long-lead Forecasts:
<http://www.usatoday.com:80/weather/wout00.htm>

National Climatic Data Center (NCDD)
<http://www.ncdc.noaa.gov>

Water Resources Monitoring

USGS Water Resources Information
<http://h2o.usgs.gov>

Natural Resources Conservation Service's Water and Climate Center
<http://www.wcc.nrcs.usda.gov/water/quantity/westwide.html>

U.S. Army Corp of Engineer's Institute for Water Resources
<http://www.wrc-ndc.usace.army.mil/iwr/currpt.htm>

El Nino/La Nina

CPC's El Nino Monitoring and Analysis
http://nic.fb4.noaa.gov/products/analysis_monitoring/ensostuff/index.html

NOAA/PMEL/TAO El Nino Theme Page
<http://www.pmel.noaa.gov/toga-tao/el-nino/home.html>

Climate Diagnostics Center's El Nino Analysis and Prediction
<http://www.cdc.noaa.gov/ENSO>

El Nino in the Western United States, Hawaii and Alaska
<http://www.wrcc.sage.dri.edu/enso/enso.html>

USA Today's El Nino Information Page
<http://www.usatoday.com/weather/nino/wnino0.htm>

Miscellaneous

National Drought Mitigation Center's *Places to Go*
<http://enso.unl.edu/go/go.htm>

Forest Service's Wildland Fire Assessment System
<http://www.fs.fed.us/land/wfas/welcome.htm>

Bureau of Reclamation
<http://www.ubr.gov>